U.S.A. 146 Exh P. 160

# Mosquito News

Published Quarterly
by the
AMERICAN MOSQUITO CONTROL ASSOCIATION

VOLUME 6 SEPTEMBER, 1946 NUMBER 3

## CONTENTS

ARTICLES PAGE

Notes on the *Neotropical* Anophelinae in Moengo, Surinam ..... D. C. Geijskes 113
Experiments with New Equipment for Mosquito Control.
Stephen S. Easter, Eugene J. Gerberg, and David A. Young 118
Some Observations on the Larval Habitat of *Psorophora varipes* (Coq.) *(Diptera: Culicidae)* ..... William F. Buren 120
Studies on the Use of Fluorescent Dyes for Marking *Anopheles Quadrimaculatus* Say.
H. T. Chang 122
The Identification of *Anopheles bradleyi* Larvae ..... Harold L. Dodge 125
Development of Nonwettable DDT Dusts for Use Against Anopheline Larvae.
John D. Maple, Howard A. Jones, Christian C. Deonier and Edna Hinchey 127
A Preliminary List of Mosquitoes Occurring in the Vicinity of Nome, Alaska.
H. H. Stage and E. A. McKinlay 131

ASSOCIATION NEWS
Report of the May 24–25, 1946 Meeting, Continued ..... 132
The Past, Present and Future of Chemical Mosquito Control ..... Duncan E. Longworth 132
A Resume of the Papers Presented at the Annual Meeting of the Florida Anti-Mosquito Association ..... Duke Peters 136
Possible Utilization of the Newly Developed Aerosol Methods in Applying the New Jersey Mosquito Larvicide for Out-Door Protection from Adult Mosquitoes .... J. M. Ginsburg 137
Ground Spraying Equipment ..... Ray H. Sammis 140
DDT, TIFA, and the Polio Epidemic at San Antonio, Texas ..... Frank K. Steinrock 141
Association Business ..... 154

NEWS AND NOTES ..... 158

EDITORIAL SECTION
The Drive for New Members ..... R. D. G. 161

REVIEWS AND ABSTRACTS
Bromeliad Malaria in Trinidad, British West Indies. By W. G. Downs and C. S. Pittendrigh.
Helen Sollers 162
The Mosquitoes of the Southern United States East of Oklahoma and Texas. By Stanley J. Carpenter, Woodrow W. Middlekauff, and Roy W. Chamberlain ..... Alan Stone 162
Use of Insect Repellents and Miticides. By B. V. Travis and F. A. Morton ..... D. L. C. 163
Estudio Ecologico de los "Criaderos" de *Anopheles pseudopunctipennis*. By G. Dennler de la Tour ..... D. L. C. 163
Field Bulletin of Malaria Control in War Areas, U. S. Public Health Service, Federal Security Agency ..... D. L. C. 163
Malaria Control in a Nonendemic Area. By Herman L. Fellton, Ralph C. Barnes, and Arlie Wilson ..... D. L. C. 163
Malaria Control in the Northeastern States. By Herman L. Fellton, Ralph C. Barnes, C. Arlie Wilson, and Miriam Boyers ..... D. L. C. 163
An Old Chemical Compound Revealed as an Exceedingly Potent Insecticide. By J. G. Sanders ..... D. L. C. 164

GENERAL BIBLIOGRAPHY ..... H. H. Stage 165

LIST OF ADVERTISERS ..... IX

ADVERTISING RATES ..... IX

# MOSQUITO NEWS

Official Organ of the American Mosquito Control Association
Formerly of the Eastern Association of Mosquito Control Workers



EDITORIAL BOARD

Editor, R. D. Glasgow, Albany, New York

Associate Editor (Make-up and Production), D. L. Collins, Albany, N. Y.

Associate Editor (Current Bibliography—"References to Literature of Interest to Mosquito Control Workers"), H. H. Stage, Washington, D. C.

Associate Editor (Reviews and Abstracts), Helen Louise Trembley, Bethesda, Md.

Business Manager, C. T. Williamson, Yaphank, New York

Secretary-Treasurer of the Association
T. D. Mulhern, New Brunswick, N. J.

PUBLICATIONS COMMITTEE

R. D. Glasgow, Chairman, Albany, N. Y.
C. T. Williamson, Yaphank, N. Y.
T. D. Mulhern, New Brunswick, N. J.
H. H. Stage, Washington, D. C.
Robert Matheson, Ithaca, N. Y.
J. T. Hart, Morris Plains, N. J.



Published by
AMERICAN MOSQUITO CONTROL ASSOCIATION

Printed by
Boyd Printing Company, Inc., Albany, N. Y.

A quarterly journal published on the 20th of March, June, September and December. Devoted to the improvement and the sound extension of mosquito control and related work as a vital public service.

SUBSCRIPTION RATES

$3.00 per Year (U. S. money), Single Copies, 75 cents.
Mailed without charge to members of the Association.

MEMBERSHIP DUES

Associate Members ..... $2.50
Active Members ..... 4.00

BUSINESS COMMUNICATIONS

Communications relating to editorial matters and manuscripts submitted for publication in Mosquito News should be addressed to Boyd Printing Co., 374 Broadway, Albany 7, N. Y., or to Dr. Robert D. Glasgow, Editor, Mosquito News, New York State Museum, Albany, New York.

Communications relating to advertising space should be addressed to C. T. Williamson, Business Manager, Mosquito News, c/o Suffolk County Mosquito Extermination Commission, Yaphank, New York.

Communications relating to subscriptions to Mosquito News, Membership in the American Mosquito Control Association, and other association matters should be addressed to Thomas D. Mulhern, Secretary-Treasurer, American Mosquito Control Association, New Brunswick, New Jersey.

Application for entry as second class matter at the Post Office at Albany, N. Y., pending.



Copyright 1946 by
The American Mosquito Control Association

# ARTICLES

## NOTES ON THE NEOTROPICAL *ANOPHELINAE* IN MOENGO, SURINAM

D. C. GEIJSKES

Entomologist, Agricultural Experiment Station, Paramaribo, Dutch Guiana

The several species of *Anopheles* which occur in the tropical forests of the Guianas are the cause of considerable malaria. Every settlement within these forests must consider the danger of this disease. In fact, the efficiency of the sanitary measures undertaken for controlling malaria is responsible for the success or failure of the industry wishing to colonize.

In Dutch Guiana, or Surinam, the village of Moengo, with a population of about 1500, is 130 miles east of Paramaribo in the bush of the upper Cottica River. It was developed by the Surinaamische Bauxite Maatschaapij in 1920, for the personnel employed in the bauxite mine. Since its beginning Moengo has grown steadily and now represents a veritable island of civilization deep in dense virgin jungle.

Since 1920 several malaria epidemics have been suffered by the population. Persistent malaria control measures however have reduced the infection until today practically no malaria occurs.

Badly infected Bushnegro and Indian villages nearby form a constant threat to Moengo and for this reason a constant mosquito control and survey as well as a medical inspection of the inhabitants of Moengo and the surrounding villages is desirable.

In August 1944, Dr. I. Guischerit, physician of the hospital in Moengo, sent me some Anophelinae for determination. I was much surprised to find in the collection not the common *Anopheles aquasalis,* nor *A. darlingi,* the widespread malaria carrier in the interior, but a rare mosquito *Anopheles pessoai,* which seems to be new to this country. Encouraged by this finding, we both became more interested in the Anophelinae population of Moengo and several collections followed. Besides additional specimens of *A. pessoai,* individuals of *Anopheles aquasalis* and *A. oswaldoi* were also received. In spite of a careful search for *Anopheles darlingi,* especially in the Bushnegro villages in the bush around Moengo, not one could be found. A person especially trained in mosquito catching did not find a single Anopheline mosquito after a visit of six days and nights in one of these villages.

One week previous to this search for Anophelines Dr. Guischerit took 71 blood smears in the same village. Of these 48 per cent were infected with *Plasmodium.* The infection among the children, less than 12 years old, was 55 per cent. These data show clearly that a dangerous malaria carrier is present.

During a visit to Moengo early in May 1945, Dr. Guischerit and I planned a systematic program for catching mosquitoes for the purpose of recording the present species of *Anopheles,* to locate their breeding places, and to recognize their relationship with the seasons. Especially, we noted the relationship of rainfall to their abundance.

Since there is little known about the ecological relationships of neotropical Anophelinae, it appeared appropriate to publish these notes although the observations are far from complete. Moreover these observations will form an introduction to the systematic mosquito-trap records, which H. H. Stage, entomologist of the Bureau of Entomology and Plant

Quarantine, Washington, D. C., arranged during his experiments in Moengo with water-dispersible DDT in March and April 1946.

### *Anophelines Hitherto Recorded*

In the samples identified between August 1944 and March 1946, seven species of *Anopheles* were represented. These are *Anopheles aquasalis, A. oswaldoi, A. pessoai, A. apicimacula, A. mediopunctatus, A. shannoni,* and *A. peryassui. A. pessoai* and *A. shannoni* have not been found before in Surinam, but are recorded from Venezuela, Colombia and Brazil and the latter also from British Guiana. Their occurrence in Surinam is not surprising; but it is noteworthy that *A. pessoai* is now the most abundant Anopheline in Moengo, and that *A. oswaldoi* and *A. aquasalis* are also common. The other species appear only seldom.

In the earlier reports of the Anopheline records of Moengo by Dr. Bonne and his wife Dr. Bonne-Wepster and given in their book "Mosquitoes of Surinam" (1925) we find a remarkable difference from the present fauna. These workers announce the following species from Moengo; *Anopheles nimbus, A. eiseni, A. "tarsimaculata" (=aquasalsis* and *oswaldoi), A. intermedius, A. argyritarsis (—darlingi,* of which is noted: "At Moengo we found them breeding several times in swampy places with many algae."), *A. peryassui* and *Chagasia fayardi.*

With the exception of *A. peryassui* and *A. "tarsimaculata"* none of these species have been collected by us. This difference is interesting for it no doubt is indicative of the greatly changed environment during the last 20 years. The bush, or virgin jungle, is cleared for a distance of a mile or more from the center of Moengo. After the bauxite hills were opened, pools filled with rainwater and remained in the old minefields. The water in these pools is highly aluminous making them unfavorable as a breeding place for the original mosquito species but perhaps favorable for others.

In the lower places adjacent to the banks of the Cottica River, a polderland on which cattle graze has been formed. This sunny lowland meadow also presents very different conditions from the densely shaded virginal jungle. Eastward on the road to Albina for a distance of a mile or so a settlement of Javanese laborers sprung up with the result that the original jungle swamps are now replaced by rice fields.

### *Distribution of the Species and Their Relation to Malaria*

Most of the collecting was done in 10 places distributed over the area of Moengo from west to east. They are indicated in Table 1, together with the collected species of *Anopheles,* as follows:

TABLE 1

| *Anopheles* | Old Tank Yard | Dynamite Houses | Old Mine | Athletic Field | Market | Village Houses | Farm | Incinerator | New Mine | Railroad East of Moengo |
|---|---|---|---|---|---|---|---|---|---|---|
| *apicimacula* | x | | x | | | x | x | | | x |
| *aquasalis* | x | x | x | x | x | x | x | | x | x |
| *oswaldoi* | x | x | x | x | x | x | x | x | x | x |
| *pessoai* | x | x | x | x | x | x | x | x | x | x |
| *mediopunctatus* | x | x | x | | x | | x | x | x | x |
| *peryassui* | x | | | | x | | x | | | x |
| *shannoni* | | | | | x | | | | | |

From this table we see that six of the seven Anophelines are found at the Oil Tank Yard, the Farm and on the railroad to Rikanau Hill, east of Moengo. These areas are situated on the outskirts of the cleared area, which means that they are not far away from the original jungle forest and are probably under the influence of the original mosquito fauna.

The other areas, especially the village, show a smaller number of species. This may be the result of unfavorable environment to the bush-loving Anophelines. The most common species in the village is *A. pessoai,* which up until now has been represented only by females. Its breeding places have not yet been located.

*A. oswaldoi* and *A. aquasalis* are found distributed over the Moengo area especially in the weed-covering open spaces outside the village.

The other species such as *A. apicimacula, A. mediopunctatus, A. peryassui* and *A. shannoni* appear only occasionally. Since they have been found mostly in the edges of the cleared area, they no doubt come from the surrounding jungle.

From a practical point of view it is important to know the relation of the species of *Anopheles* to malaria. However, it is difficult to get complete information regarding their efficiency as carriers of the disease. Attention may be called to the fact that in an infected region, malaria decreases with the clearing of the bush. This probably means that the breeding places are changed ecologically hence the development of the dangerous species no longer exists. As long as the area is within the reach of the Anopheline the inhabitants of that place will still exhibit malaria. When the jungle is cleared from an area larger than the normal flight range of the carrier, malaria will disappear. This does not mean that the Anophelines will not be present but it

TABLE 2. Number of Anophelines Collected by Months.

| | Rainfall in mm. | Average rainfall * | *A. aquasalis* | *A. oswaldoi* | *A. pessoai* | *A. apicimacula* | *A. mediopunctatus* | *A. peryassui* | *A. shannoni* | Total number |
|---|---|---|---|---|---|---|---|---|---|---|
| *1945* | | | | | | | | | | |
| Apr. | 166 | (262) | 10 ♀ | | | 1 ♀ | | | | 11 ♀ |
| | | | | | | 1 ♂ | | | | 1 ♂ |
| May | 350 | (363) | 7 ♀ | | 41 ♀ | 2 ♀ | | | | 50 ♀ |
| June | 282 | (292) | 27 ♀ | 1 ♀ | 111 ♀ | | 1 ♀ | | | 140 ♀ |
| | | | 2 ♂ | | | | | | | 2 ♂ |
| July | 225 | (267) | 75 ♀ | | 268 ♀ | | 4 ♀ | 3 ♀ | 1 ♀ | 351 ♀ |
| | | | 3 ♂ | | | | | | | 3 ♂ |
| Aug. | 192 | (152) | 11 ♀ | | 17 ♀ | | | | | 28 ♀ |
| Sept. | 30 | (69) | 11 ♀ | 87 ♀ | 2 ♀ | | | | | 100 ♀ |
| | | | | 4 ♂ | | 1 ♂ | 1 ♂ | | | 6 ♂ |
| Oct. | 89 | (68) | 25 ♀ | 128 ♀ | 6 ♀ | | 2 ♀ | | | 161 ♀ |
| | | | | 9 ♂ | | 1 ♂ | | | | 10 ♂ |
| Nov. | 135 | (121) | | 38 ♀ | 15 ♀ | | 2 ♀ | 1 ♀ | | 56 ♀ |
| | | | | 1 ♂ | | | | | | 1 ♂ |
| Dec. | 411 | (255) | 10 ♀ | 38 ♀ | 10 ♀ | 3 ♀ | 2 ♀ | | | 63 ♀ |
| *1946* | | | | | | | | | | |
| Jan. | 267 | (228) | 21 ♀ | 10 ♀ | 7 ♀ | 1 ♀ | | 1 ♀ | | 40 ♀ |
| Feb. | 71 | (112) | 23 ♀ | 50 ♀ | 25 ♀ | 3 ♀ | | | | 101 ♀ |
| March | 149 | (158) | 3 ♀ | 85 ♀ | 40 ♀ | | 1 ♀ | 1 ♀ | | 130 ♀ |

* Braak, 1935.

does mean that those species living and breeding in the open area, are generally harmless. We must consider, however, that in this case we are not fully informed about most of them. Of the species under consideration, the following data are given in Russell, Rozeboom and Alan Stone 1943, Bonne & Bonne-Wepster 1925.

| *Anopheles* | *Relation to malaria* |
|---|---|
| *aquasalis* | An important vector in many localities. "We could infect (tarsimaculata) in Paramaribo with malarial parasites without any difficulty" (Bonne & Bonne-Wepster, p. 515). |
| *oswaldoi* | Not determined |
| *pessoai* | Unknown |
| *apicimacula* | Data inadequate |
| *mediopunctatus* | Unknown |
| *shannoni* | Unknown |

From this list we see that *A. aquasalis* is a dangerous species. Of the other species, however, our knowledge is too incomplete to determine their role as transmitters of malaria.

*Dependence of the Species on Rainfall*

One of the main factors in the tropics to which the mosquito population reacts, is rainfall. In Surinam the principal rainy season is from May until August and there is a corresponding dry season from September through November. A short rainy season exists from December to February. This is followed by a short dry season from February through March. The heavy rainy season and the principal dry season are fairly constant but the shorter seasons are irregular.

The average rainfall for the year in Moengo amounts to 2400 mm. (100 inches), and is shown by months in Table 2. Also in this table the total number of each species is recorded for each month.

It is evident from these data that *A. aquasalis, A. oswaldoi,* and *A. pessoai* are dominant while the other ones although represented almost monthly were collected only in very small numbers. Because of the few individuals collected, we do not attempt an interpretation of their importance. Of the three species *A. pessoai* is the most numerous, second in importance is *A. oswaldoi,* while *A. aquasalis* appears regularly although in moderation.

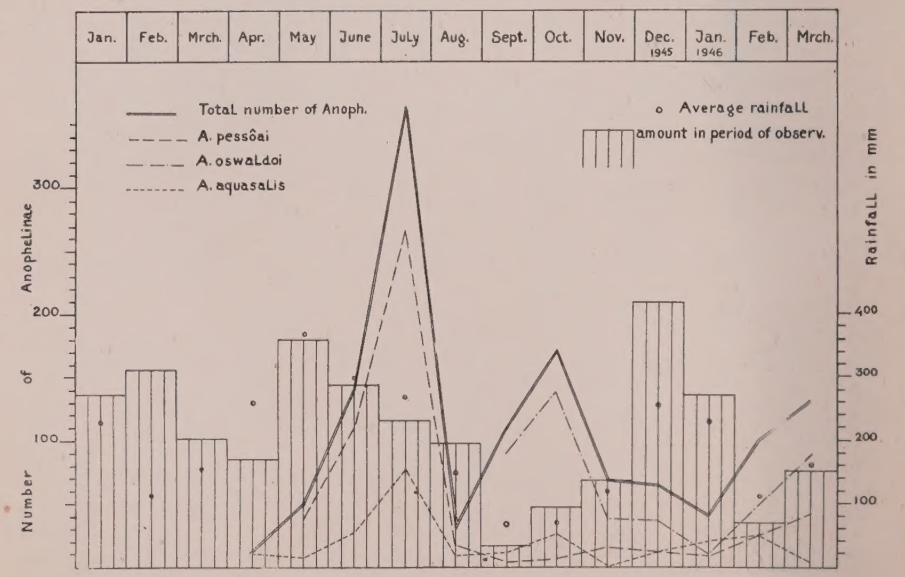



FIG. 1. Relation of precipitation to seasonal abundance of Anopheline species observed.

*A. aquasalis* and *A. pessoai* are most abundant in July. *A. oswaldoi* is most numerous in October, and slightly less so in March. This means the *A. aquasalis* and *A. pessoai* are dependent on the big rainy season, but that *A. oswaldoi* is prevalent in the dry season. Insofar as our information goes, it seems also that the other species are dependent on the rainy seasons.

When we consider the total anopheline population in the different months of the year, it becomes evident that there are three maxima: the largest one in July, in the middle of the big rainy season; the second one in October, in the middle of the dry season; and the third one in March in the middle of the short dry season.

The observations are best demonstrated graphically, Fig. 1. The influence of the rainfall on the presence of *A. pessoai* and of *A. aquasalis* is clear. The presence of *A. oswaldoi* in the dry seasons is also evident. The curve clearly demonstrates that the peak in July is due mainly to *A. pessoai* and to a less extent by *A. aquasalis,* but that the other two peaks in October and March, are caused by *A. oswaldoi.*

From these data we may conclude, that of the seven species of *Anopheles* found in Moengo, only three appear dominant as follows: *A. pessoai, A. oswaldoi, A. aquasalis.* Among these species we recognize two as reaching their peaks in the big rainy season (July), whereas only one dominates in the dry season (October, March).

Since the above information was obtained extensive collections of mosquitoes were made possible by the use of new traps imported by H. H. Stage, in connection with a study of the mosquito population before and after treatment with a water dispersible DDT. These data will no doubt increase our knowledge on the seasonal abundance of these species.

*Summary*

1. The jungle surrounding Moengo, Surinam, is inhabited by seven species of *Anopheles* some of which are dangerous carriers of malaria. They are a constant threat to every settlement in the interior.

2. Records made twenty-five years ago, however, show that five other species were found. These include the dangerous *A. darlingi,* which is now superseded by the dominant *A. pessoai,* not previously known in Surinam.

3. The differences are probably the result of ecological changes caused by the mining of bauxite and the clearing of jungle over a large area.

4. The dominant species today are *A. pessoai, A. oswaldoi* and *A. aquasalis* and they seem to breed in ricefields, pools in the mining fields, and the ditches around the village which did not exist 25 years ago.

5. The dependence of these dominant species upon the rainfall was demonstrated by a correlation of the abundance of the species with the total amount of rainfall in Moengo. In this respect *A. pessoai,* and *A. aquasalis* proved to be directly influenced, whereas *A. oswaldoi* is most abundant during the dry season.

*Resumen*

1. En la maraña que rodea Moengo, Guyana holandesa, viven siete especie del género *Anopheles,* algunas de las cuales son transmisores peligrosos del paludismo. Son una amenaza continua a cada poblado en el interior del país.

2. Datos de hace veinticinco (25) años, muestran, sin embargo, que se encontró otro cinco especie. Entre éstas es la peligrosa *A. darlingi,* que la dominante *A. pessoai,* antes ignota en la Guyana holandesa, ahora reemplaza.

3. Las diferencias son probablemente a causa de cambios ecológicos producidos por la mineria de la bauxita y la enorme aclaración de la manaña.

4. Las especie dominantes hoy día son *A. pessoai, A. oswaldoi,* y *A. aquasalis,* y parece que multiplican en campos de arroz, hoyos en los campos de mina, y en zanzas en el pueblo que no existían hace veinticinco (25) años.

5. El apoyo de estas especie dominantes al aguacero se mostró por una correlación

de la abundancia de la especie con todo el aquacero en Moengo. En cuanto a esto, se probó que *A. pessoai* y *A. aquasalis* están influidas directamente, mientras que *A. oswaldoi* es el más abundante durante la estación seca.

(Author's English summary translated into Spanish by Mr. Clark Collins through the courtesy of Miss Helen Sollers.)

*References*

BONNE, J., AND BONNE-WEPSTER, J. 1925. Mosquitoes of Surinam. Roy. Col. Inst. Amsterdam, Paper No. XXI, Dept. Trop. Hyg. No. 13.

BRAAK, C. 1935. The Climate of the Netherlands West Indies. Kon. Nederl. Meteor. Inst. No. 102, Meded. en Verh. 36.

RUSSELL, P. F., ROZEBOOM, L. E., AND ALAN STONE. 1943. Keys to the Anopheline Mosquitoes of the World. The Am. Ent. Soc., Acad. Nat. Sc., Pa.

# EXPERIMENTS WITH NEW EQUIPMENT FOR MOSQUITO CONTROL

STEPHEN S. EASTER,[1] EUGENE J. GERBERG,[2] AND DAVID A. YOUNG [3]

The control of mosquitoes is frequently retarded or rendered ineffective by inability to reach prolific breeding areas. At Edgewood Arsenal, Edgewood, Maryland, there are many vegetation choked bayheads so dense that larviciding by hand sprayers or conventional power sprayers is almost impossible. A recently developed turbine type sprayer and duster seemed to offer considerable possibilities because of its capacity and range, using both larvicidal and residual DDT. This piece of equipment weighing approximately 400 pounds empty was mounted on an Army amphibious vehicle usually called a "weasel," which permitted access into all parts of marshy bayheads except open water.

Two pictures are included showing the mounting on the weasel and the use of the turbine type sprayer-duster in a marsh with 10 per cent DDT dust. In addition a DDT-xylene emulsion was used at the rate of 0.16 pounds of technical DDT per gallon of emulsion and a concentrated spray using 0.43 pounds of DDT dust per gallon, with linseed oil as a sticker. The machine handled these preparations without difficulty, permitting heavy larviciding and residual treatment over the marsh, with particular emphasis at the edges. The distance effectively reached from the sprayer depended on the wind. The emulsion gave a good deposit on glass 240 feet across a mild breeze of about 5 miles per hour. At this point there was a fall of varied insects under large trees. With a favorable wind the emulsion should easily reach 300 feet or more.

The DDT dust and linseed oil preparation was also tested with a fish-tail nozzle on ornamental shrubs and trees 20 feet or less in height. An excellent deposit was obtained indicating a probable use against leaf eating insects.

It was concluded that the turbine type sprayer-duster mounted on a weasel is another useful piece of equipment for mosquito control, not only in marsh, but in wooded, poorly drained areas where all weather equipment is needed.

[1] Entomologist, Office of Engineer, Second Army.

[2] Captain, Sanitary Corps Reserve.

[3] Second Lieutenant, Sanitary Corps.

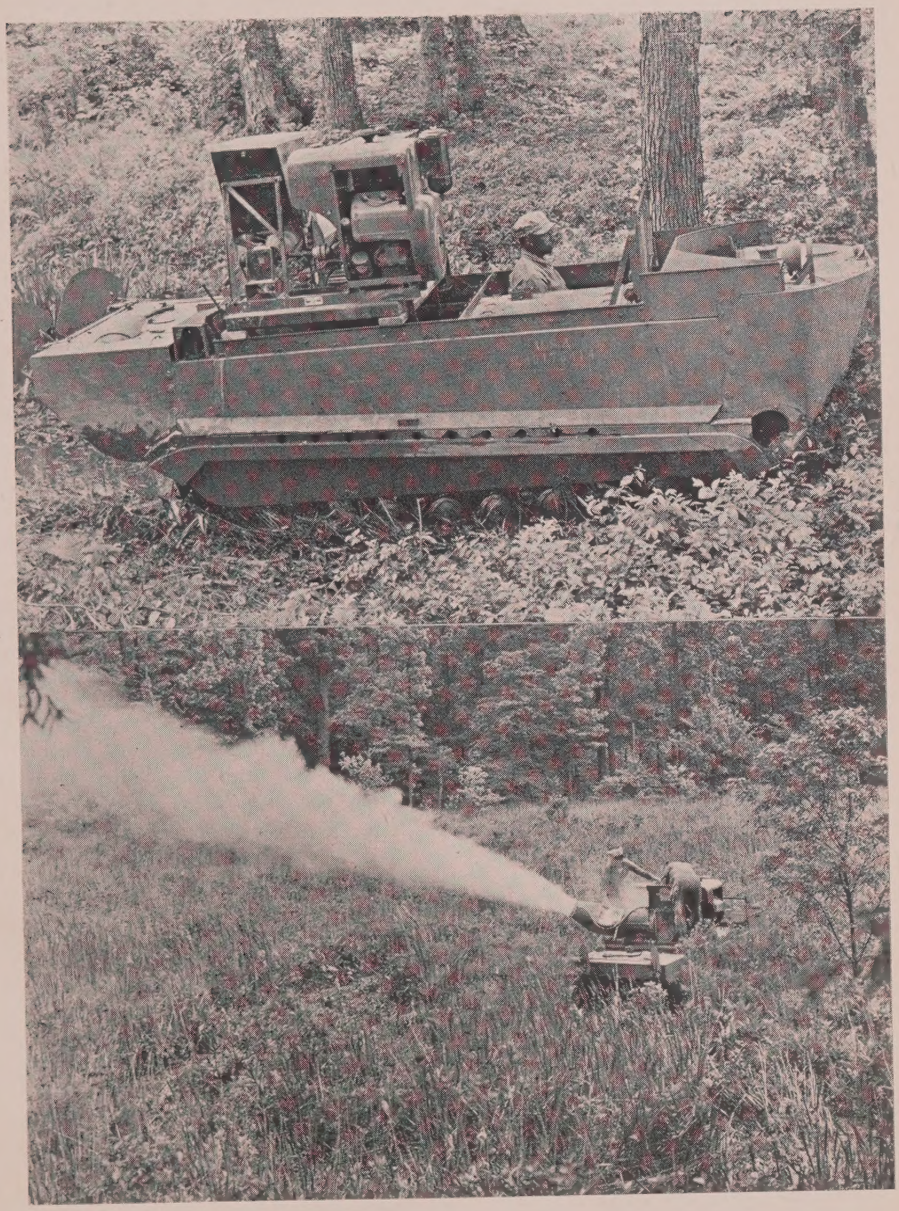


Fig. 1. Turbine type sprayer-duster mounted on a weasel.

Fig. 2. The unit shown in Fig. 1 applying 10% DDT dust in a marsh.

# SOME OBSERVATIONS ON THE LARVAL HABITAT OF *PSOROPHORA VARIPES* (COQ) *(DIPTERA: CULICIDAE)*

WILLIAM F. BUREN
Asst. Sanitarian (R), U. S. Public Health Service

*Psorophora varipes* (Coq.) is at certain times and places a very abundant and annoying biter. King, Bradley and McNeel (1) record it as being exceedingly annoying in the woods around Mound, La. Horsfall (2) and Carpenter (3) report the species as occurring in large numbers after the spring floods in Arkansas. In the writer's experience, *Psorophora varipes* was very numerous in the spring during the years 1943, 1944, and 1945 around Alexandria, La.

In spite of this adult abundance, the larvae are seldom seen and are rare in collections. They are usually thought to breed in temporary rain pools as does the common related species, *Psorophora ferox*. That the larval environment may be somewhat different, however, is indicated by some observations made by the writer at Alexandria.

First of all, it was noticed that *Psorophora varipes,* while present in many wooded areas, was abundant only in the dense, swampy lowlands, particularly those that were flooded by overflowing streams and rivers. Favored haunts seemed to be the Bayou Ricolette woodlands, about 2 miles northwest of Alexandria; the Little River swamplands, approximately 20 miles northeast of Alexandria; and the Bayou Beouf swamplands, about 5 miles south of Alexandria. All of these flooded extensively each spring.

During 1944, small collections up to 15 *Psorophora varipes* were found accidentally in the Bayou Ricolette and Little River flood waters. They were found among floating debris (dead twigs, leaves, etc.) together with the larvae of *Anopheles crucians,* or where the larvae of *A. crucians* and *A. quadrimaculatus* soon after appeared.

The Bayou Beouf swamplands were selected for special observations in 1945. This region not only contained extensive overflow areas but also large tracts of flatwoods containing innumerable temporary rain pools. These pools had been searched carefully for several years, without finding any *P. varipes* larvae, although the larvae of *Psorophora ferox, Aedes canadensis, A. grossbecki, A. vexans, A. atlanticus, A. tormentor, A. infirmatus, Culex apicalis,* and others were at times numerous or abundant.

In 1945, the pools and flooded areas were first surveyed in February. No larvae of any species were found in the flooded areas although the rain pool areas contained *Aedes canadensis* and *A. grossbecki* larvae. The development of these larvae continued slowly through February with pupation and emergence occurring in early March. By the middle of March, the flood waters had receded and most of the ground pools had dried because of a temporary cessation of the spring rains.

On the evening of March 18, 1945, a heavy rain once more flooded the overflow areas and filled the rain pools. The next day two first instar *Psorophora* larvae were found in floating debris in the overflow areas. On March 20, the area was flooded somewhat more extensively by another rain. On March 22, adult *P. varipes* were numerous (on all previous occasions they had been absent) and third and fourth instar larval *P. varipes* were abundant, averaging three or four to the dip. The larvae were found in the floating mats of debris, especially in those places which had been flooded by the rain of March 20. A few pupae also were present. On March 25, adults were present in hordes but larvae and pupae were absent.

During this same period, the larvae of *Psorophora ferox* became abundant in the temporary rain pool areas but no *P. varipes* could be found. In April, however, a single specimen of *P. varipes* was collected by Mr. J. A. Fontenot from a temporary rain pool near Alexandria, La.

During April, other woodlands began to show the presence of adult *P. varipes*. These adults, in the writer's opinion, migrated from the floodwater breeding areas. The temporary pool breeding around Alexandria appears to be too rare to account for their numbers. *P. varipes* may have a much longer flight range than previously suspected, infiltrating many wooded places where it does not breed at all.

### *Characteristics of* Psorophora Varipes *Larvae*

The larval chaetotaxy of *Psorophora varipes* has been adequately treated by other writers; however, there are several characters and habits which may show adaptation to their environment which have not been previously noted.

1. Shape of the airtube: In *P. varipes* the airtube is quite slender, little wider at the middle than at the base or apex, and without the inflated appearance common to *Psorophora* larvae.

2. Coloration: The head is entirely black and the airtube is black on the basal two-thirds, turning pale towards the apex. The dorsum of the body is pale, but the venter has definite black markings. This color pattern may be described as follows: On venter of thorax, an indistinct central mass traversed by three very dark curved bars. On the anterior abdominal segments; wide bands of solid color covering nearly all of the segment; the anterior edges of the bands are convex in the middle, concave towards the sides (bow-shaped); the posterior edges are concave. On the more posterior segments the anterior edges of the bands become more bowed. The posterior edges develop a median projecting angle and usually there are one or two clear spots medially in the band. On the 8th segment the banding is reduced to a small chevron-like band with the center missing.

3. Movement: The larvae even when captured are relatively inactive except for the rapid and constant action of the mouth bristles which draws the larvae about through the water.

4. Growth rate: The aquatic stages of *P. varipes* apparently are passed with extreme rapidity, the whole cycle from hatching to adult occurring in 4 to 6 days.

These characters appear to be adaptive to their peculiar environment, their lack of movement and ventral dark coloration enabling them to be invisible to fish while lying under the mats of debris, the slender airtube being better fitted for piercing the covering mat than the typical bulky airtube usually found in *Psorophora*. The very rapid growth is necessary for completion of development in the transitory flood waters.

### *Summary*

1. Near Alexandria, La., *Psorophora varipes* were found to be breeding abundantly in woodland flood waters and to be nearly absent in the temporary rain pools. This may explain the relatively few larval collections of *P. varipes*.

2. *Psorophora varipes* larvae show certain adaptative characters and habits which fit them for breeding in mats of floating debris in woodland flood waters: (A) Dark ventral protective coloration; (B) Minimum of movement; (C) Slender airtube; (D) Rapid growth rate.

### *References*

(1) KING, W. V., BRADLEY, G. H., MCNEEL, T. E. The Mosquitoes of the Southeastern States, U. S. Dept. Agric. Misc. Public. No. 336, Revised 1944.

(2) HORSFALL, W. R. Occurrence and Sequence of Mosquitoes in Southeastern Arkansas in 1935. Journal Econ. Ent. 29:676–679, 1936.

(3) CARPENTER, S. J. The Mosquitoes of Arkansas. Rev. ed., Ark. State Bd. of Health, 87 pp., illus., 1941.

# STUDIES ON THE USE OF FLUORESCENT DYES FOR MARKING *ANOPHELES QUADRIMACULATUS* SAY

H. T. CHANG [1]

The National Insecticides and Sprayers Experimental Plant,
Ministry of Agriculture and Forestry, Shanghai, China

## *Introduction*

In order to study the flight range of mosquitoes under natural conditions, a number of workers have tried staining larvae or marking adults with metallic dyes in the form of solutions or dusts. Recently fluorescent compounds have been successfully used to mark *Anopheles* mosquitoes (Zukel, 1945). By the use of this method, a large number of specimens can be readily marked and recognized when subsequently collected in a matter of a few minutes. No details have been given concerning the toxic effect caused by the marking and how long the marking would last. The present paper is a report of a seven-week study on the use of fluorescent dyes for staining and marking the larvae and adults of *Anopheles quadrimaculatus* during my visit in the Health and Safety Department, Tennessee Valley Authority, Wilson Dam, Alabama.

## *Materials and Methods*

Anthracene, rhodamine B, and fluorescein were used for staining larvae as well as for adult marking. For the larvae, 20 or 50 early fourth instar larvae as a lot were stained in a crystallizing dish, thus giving a 24 to 48 hour staining period before pupation. Since rhodamine B is not readily dissolved and anthracene is not dissolved at all in water, they were first allowed to dissolve in a few ml. of acetone in the later part of the experiment. This gave a complete solution of rhodamine B and a dispersible suspension of anthracene in water. Stained larvae were kept in the insectary at a constant temperature of about 76° F. and a relative humidity of about 70. Regular ground dog food was offered until the time of pupation was reached.

Stained larvae were allowed to emerge into lantern globes and killed either by heat or cooling or by chloroform mosquito catching tubes. Care was taken to disturb the emerged mosquito as little as possible. Killed specimens were examined under an ultra-violet light which will turn anthracene, rhodamine B, and fluorescein into blue, red, and green fluorescent colors, respectively. The light was obtained from a high-pressure mercury vapor lamp with its ballast transformer and two Corning glass filters, #5840 red-ultra and #4308 light shade blue green. Dissection was made when it appeared necessary.

For the adult marking 1–2 day old mosquitoes were released into a quart ice cream carton and covered at both ends with bobbinet cloth. They were heavily sprayed with a home-made atomizer consisting of a 200 ml. flask fitted with a rubber bulb and a smoothly curved outlet tube. One part of anthracene was mixed with six parts of gum arabic, whereas the other two were mixed with four parts. Marked specimens were transferred into clean holding screen cages which had a diameter of 8 inches and a length of 16 inches and kept in the insectary. Only sugar solution was given during the test period. Dead mosquitoes were taken out and examined every day.

## *Results*

### *Larvae Staining*

The results obtained from staining larvae in vitro were not satisfactory. They are summarized in Table 1. The per-

[1] The writer expresses his appreciation for helpful suggestions and the laboratory facilities given by A. D. Hess.

TABLE 1. Mortalities of Larvae Stained in Vitro with Fluorescent Dyes.

| Fluorochrome | Dilution | Larvae Used | Larvae Emerged | Percentage of Mortality (D–C/T–C x 100) |
|---|---|---|---|---|
| | *Lot No. 1* | | | |
| Check (no dye) | 200 ml. of water | 50 | 16 | |
| Anthracene | 1:4,000 (50 mg. in 200 ml. of water) | 50 | 0 | 100 |
| Rhodamine B | " | 50 | 0 | 100 |
| Fluorescein | " | 50 | 0 | 100 |
| Anthracene | 1:8,000 (25 mg. in 200 ml. of water) | 50 | 4 | 75 |
| Rhodamine B | " | 50 | 0 | 100 |
| Fluorescein | " | 50 | 9 | 43.8 |
| | *Lot. No. 2* | | | |
| Check (without acetone) | 100 ml. of water | 20 | 13 | |
| Check (with acetone) | 100 ml. of water | 20 | 6 | 53.8 |
| Anthracene | 1:8,000 (12.5 mg. in 100 ml. of water) | 20 | 4* | 69.2 |
| Anthracene | 1:10,000 (10 mg. in 100 ml. of water) | 20 | 7** | 46.1 |
| Rhodamine B | 1:10,000 (10 mg. in 100 ml. of water) | 20 | 0 | 100 |

* 1 specimen dead upon emergence.
** 2 specimens dead upon emergence.

centage of mortality was calculated by the formula D–C/T–C x 100, where T was the total number used in the test, D was the number of dead in the test, and C was the number of dead in the check.

One adult from a larva marked with anthracene at 1:8,000 showed a definite blue fluorescence; one adult from a larva marked with fluorescein showed a doubtful trace of green fluorescence; all other adults gave no evidence of the fluorochromes with which the larvae were marked.

### *Adult Marking*

The results of marking adults with the three selected fluorochromes are summarized in Table 2. It will be noted that a different number of adults were used in each of the tests. This was due to the fact that it was difficult to count exactly the number of adults which were released into the ice cream carton. The adults used were about equally distributed between the two sexes, and, although the females in general survived for a greater period than the males, this did not appear to be a factor in the final results.

### *Discussion*

The results of the staining tests with larvae indicate that the materials used are too toxic to be used for this purpose. However, the results with the second lot of mosquitoes (Table 1) indicate that the high mortalities obtained with the anthracene and rhodamine B specimens may have been due to acetone rather than to the fluorochromes themselves. It appears from the observation of the few adults which did emerge that the dyes were not effectively transferred from the larvae through the pupae to the adult stage. Thus, the over-all conclusion seems warranted that the three fluorochromes would not be satisfactory for the purpose for which they were tested.

The use of anthracene, rhodamine B, and fluorescein for marking adult mosquitoes appears much more promising.

TABLE 2. Results of the Use of Fluorescent Dyes to Mark *A. quadrimaculatus* Adults.

| Period | Anthracene | | | | Rhodamine B | | | | Fluorescein | | | | Check * |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cumulative % Mortality | Effectiveness Pos. | Neg. | ? | Cumulative % Mortality | Effectiveness Pos. | Neg. | ? | Cumulative % Mortality | Effectiveness Pos. | Neg. | ? | Cumulative % Mortality |
| 1st Wk. | 16.6 | 8 | 0 | 0 | 22.2 | 8 | 0 | 0 | 2.0 | 1 | 0 | 0 | 14.3 |
| 2nd Wk. | 45.8 | 12 | 1 | 1 | 58.3 | 12 | 1 | 0 | 26.5 | 10 | 1 | 1 | 28.6 |
| 3rd Wk. | 81.2 | 15 | 2 | 0 | 91.6 | 12 | 0 | 0 | 79.5 | 24 | 2 | 0 | 38.2 |
| 4th Wk. | 93.7 | 5 | 1 | 0 | 97.2 | 2 | 0 | 0 | 91.8 | 5 | 1 | 0 | 52.4 |
| 5th Wk. | 100.0 | 3 | 0 | 0 | 100.0 | 1 | 0 | 0 | 100.0 | 4 | 0 | 0 | 81.0 |
| Totals | | 43 | 4 | 1 | | 35 | 1 | 0 | | 44 | 4 | 1 | |
| Percentages | | 89.6 | 8.3 | 2.1 | | 97.3 | 2.7 | 0 | | 89.8 | 8.2 | 2.0 | |

* A total of 21 specimens were included in the check.

Each of the materials averaged approximately 90 per cent or more effective over the 5-week period during which the observations were made. There was some indication of significantly greater mortalities in the treated specimens than in the check lot. However, survival was sufficient to make it quite feasible to use these materials in flight dispersion and flight range studies.

*Summary*

Observations were carried out over a 5-week period to determine the feasibility of using three fluorochrome dusts, namely, anthracene, rhodamine B, and fluorescein, for marking larvae and adults of *A. quadrimaculatus*. Because of high mortalities and ineffectiveness the materials are not considered suitable for marking larvae. However, all three materials appear to be quite satisfactory for use in marking adult mosquitoes.

*Reference*

Zukel, John W. Marking *Anopheles* Mosquitoes with Fluorescent Compounds. Science, August 10, 1945.

# THE IDENTIFICATION OF *ANOPHELES BRADLEYI* LARVAE

HAROLD R. DODGE

Assistant Entomologist, U. S. Public Health Service *

The larva of *Anopheles bradleyi* King was the first North American *Anopheles* larva to be differentiated. This was done by Smith (1) in 1904, in a key by which he separated *crucians* larvae from *punctipennis* and *maculipennis* by the following characters: antennae shorter, brownish; tracheal gills short. His *"maculipennis"* has since been found to be *quadrimaculatus,* and his *"crucians,"* reported to be rare in New Jersey except at Cape May, is undoubtedly the brackish water species described 35 years later as *Anopheles crucians bradleyi* King.

Numerous examples of *bradleyi* larvae have been received from Brunswick and Savannah, Georgia, and the antennae are invariably brownish, in striking contrast to all associated species, in which the brown (or yellow in pale larvae) antennae of younger instars become pale, with dark apices and sabres, in the fourth instar.

Two articles have recently been published in which distinguishing characters of *bradleyi* larvae have been proposed. Bickley (2) remarks upon the short anal gills of *bradleyi* and *atropos,* and Miles (3) found, in comparing *bradleyi* with *punctipennis* and *georgianus,* that *bradleyi* has stouter, dark-pigmented antennal spicules, and confirms the fact that the palmate hairs on abdominal segments 3 and 7 are usually reduced in size, with leaflets mostly slender and without notches or serrations on the margins. The brown color of *bradleyi* antennae has not been mentioned in the literature since this species was described, and Headlee (4) erroneously ascribes this character to *crucians* larvae. Since the brown antennae are readily distinguishable at very low magnifications, this character is here suggested as a means of easily recognizing fourth instar *bradleyi* larvae from the larvae of other common species at the time of collection.

* Contribution of the Georgia State Board of Health.

There are four other species occurring within the range of *bradleyi* (the North Atlantic and Gulf coasts, New Jersey to Mexico) in which brown antennae have been observed in fourth instar larvae. They are *barberi,* a tree hole breeder, with antennae dark brown or black; *albimanus* and *pseudopunctipennis,* both common in the lower Rio Grande valley and with antennae varying from pale to brown; and *atropos,* also a coastal species with much the same range as *bradleyi,* but which usually breeds in waters of greater salinity (5). All of these species are easily distinguished from *bradleyi* by morphological characters, notably the reduction or absence of branches of the outer clypeal hairs.

The writer has not been able to confirm Smith's statement that *bradleyi* antennae are relatively short. By actual measurement, no appreciable difference has been found in the proportions of the antennae or heads of *bradleyi* and four other common species. The length of the anal gills is variable with the salinity of the water. *Bradleyi* gills are not appreciably shorter than the gills of *crucians* or *quadrimaculatus* when those species are associated with *bradleyi.* Very rarely an injured antenna of a larva of another species of *Anopheles* is found to have turned dark.

*References*

1. SMITH, J. B. 1904. Report of the New Jersey State Agricultural Experiment Station upon the Mosquitoes Occurring within the State, Their Habits, Life Histories, etc. MacCrellish and Quigley, Trenton, N. J.
2. BICKLEY, WM. E. 1945. The Anal Gills of Mosquito Larvae. MOSQUITO NEWS, Vol. V, p. 18.
3. MILES, V. I. 1945. Differentiating the Larvae of *Anopheles georgianus* King, *A. bradleyi* King, and *A. punctipennis* (Say). Jour. Natl. Malaria Society, Vol. IV, pp. 235–242, illus.
4. HEADLEE, T. J. 1945. The Mosquitoes of New Jersey and Their Control. Rutgers Press, New Brunswick, N. J.
5. KING, W. V., BRADLEY, G. H., AND T. E. MCNEEL. 1944. The Mosquitoes of the Southeastern States. U.S.D.A. Misc. Publ. No. 336, 96 pp.

## "ABOUT NEW JERSEY"

"Like to get into a good fight?—one that can mean more comfort for you and the family this summer? Pitch in, then, with State and County agencies who are battling the pesky mosquito on a bigger scale now that more manpower is available for the job.

"You can leave it to the professionals to go after the large breeding grounds—salt marshes, fresh water swamps and flooded areas. The vicious salt marsh mosquito is said to be the most numerous kind in New Jersey, but the authorities tell us that right close behind is the 'house mosquito' and he—or rather she, *for only the ladies bite*—is where you come in.

"Use screens and sprays around the house, of course. But since mosquitoes *must* have water to breed in, go after standing, stagnant water in your vicinity. Drain it, or pour kerosene or light fuel oil over it, a pint per 100 square feet of water area. Pyrethrum or a good larvicide will kill the 'wigglers' in the water before they can emerge as mosquitoes.

"Look around your property, says the State Extension Service, for your own skin's sake and better sleep o'nights. Empty or smash old cans. Cut up or cart away old tires where water can collect. Drain clogged roof gutters. Change water in bird baths, troughs and fountains twice a week. A check-up soon after each shower and storm will pay real dividends.

"You can't get rid of them all, of course, but new repellents are available, some developed in New Jersey for our armed forces in the Pacific, and we're told they really work.

"Wouldn't it be grand to garden or just laze around outdoors free from these buzzing, biting skeeters!"

From *Tel-News,* a leaflet of which 750,000 are enclosed by the New Jersey Bell Telephone Co. with monthly telephone bills.—T. D. MULHERN.

This is just as true for other states as it is for New Jersey.—EDITOR.

# DEVELOPMENT OF NONWETTABLE DDT DUSTS FOR USE AGAINST ANOPHELINE LARVAE[1]

JOHN D. MAPLE,[2] HOWARD A. JONES, CHRISTIAN C. DEONIER, AND EDNA HINCHEY
U.S.D.A., Agr. Res. Adm. Bureau of Entomology and Plant Quarantine

The first tests of DDT against mosquito larvae at the Orlando, Fla., laboratory of the Bureau of Entomology and Plant Quarantine, were made in 1943 with a commercially prepared dust. At that time tests were under way to prepare anopheline larvicides containing arsenicals in forms that would resist wetting and, if possible, remain floating on water surfaces. Extensive tests of a similar nature were therefore initiated early in 1943 with DDT. Various coating agents and diluents were tested in an effort to develop a practical, nonwettable DDT dust. An insecticidal preparation employing combinations of DDT with stearic acid and other waxy solids is described in a patent by Deonier and Jones (1944). The data given in this patent constitute the first published report on the use of DDT against mosquito larvae.

The preparation and use of DDT larvicidal dusts has been discussed briefly by Deonier *et al.* (1945) and Jones *et al.* (1945). The present article gives more details of biological results with some of the numerous preparations made during the development of these dusts.

*Technique.* The preparation of dusts that would remain effective on water surfaces for long periods of time required a long and laborious biological test procedure. To reduce the time required as much as possible, a rather severe laboratory test was developed. A rain machine was used in which water was dropped as individual large drops from a height of 6 feet. With this machine an artificial rain of 6 inches in 3 minutes could be obtained.

A battery jar 6 inches in diameter was used for these tests. The jar was filled with about 1 inch of water, and the preparation to be tested was dusted over the water surface at a calculated dosage. The initial artificial rain was then given, bringing the water level to a mark on the jar 6 inches above the lower level.

Twenty early fourth-instar larvae of *Anopheles quadrimaculatus* Say were introduced into each jar. Mortality readings were made after 24 and 48 hours. Larvae unable to come to the surface after the rain had penetrated the dust were considered to be dead. If the mortality after 48 hours was 80 per cent or above, the rain tests were repeated at 48-hour intervals with new lots of larvae until the mortality was less than 80 per cent. In later tests a mortality of 90 per cent in 48 hours was used as a criterion. Just prior to each artificial rain the water was siphoned from the test jar until the 1-inch level was reached. The siphon was so manipulated as to remove the dead larvae from the bottom of the jar but not to remove any of the toxic material which might be present on the surface. Because of the time and effort involved in making these tests, they were not replicated extensively.

*Preparations Studied.* The first tests to decrease the wettability of DDT dusts were made by mixing the original commercial dust with stearic acid. Later, several series of dusts containing different proportions of DDT and stearic acid were prepared by various methods. One of these mixtures, on which a large number of tests were made, comprised 1 part of DDT and 4 parts of stearic acid. Other waxy solids tested were palmitic acid, stearyl alcohol, cetyl alcohol, glyceryl

[1] This work was conducted under a transfer of funds, recommended by the Committee on Medical Research, from the Office of Scientific Research and Development to the Bureau of Entomology and Plant Quarantine.

[2] Lieutenant, U. S. Naval Reserve, killed on Okinawa on April 11, 1945.

monostearate, and hydrogenated cottonseed oil (Cotoflakes). The methods used in making these preparations have been described by Jones *et al.* (1945). Most of the materials were prepared by use of a mutual solvent.

In subsequent tests, mixtures of micronized DDT with metallic stearates were found to possess marked resistance to wetting. The solvent method of preparation was first used, but later formulations were made by mechanical mixing. Calcium stearate was used in most of the preparations, but copper and zinc stearates were also tried. The dusting qualities of the DDT-stearic acid preparation (1:4) were improved when calcium stearate was mixed with it.

A number of preparations were also made of DDT mechanically mixed with talc. Micronized DDT was used in many of the early preparations, and various proportions of talc were tried. In all these tests the dusts were applied at the rate of 0.5 pound of DDT per acre and the criterion of effectiveness was a larval mortality of at least 80 per cent in 48 hours.

Comparisons were also made of the wettability of seven commercial 10 per cent DDT dusts made with talc and with pyrophyllite. In these preparations technical DDT and the diluent were milled together in an ordinary hammer or other type mill. The dusts were applied at the rate of 0.1 pound of DDT per acre, and the criterion of effectiveness was a larval mortality of at least 90 per cent in 48 hours.

*Results.* The resistance to artificial rain of the dust preparations applied at a dosage of 0.5 pound of DDT per acre is shown in Table 1. No significance is attached to the results when the duration of effectiveness differs by only a few days.

Micronized DDT alone (surface mean diameter by air permeation 6 microns) was resistant to wetting. This material, however, was difficult to prepare, tended to form lumps, and did not dust readily. The preparation containing 20 per cent of DDT and 80 per cent of stearic acid, and which had passed a 200-mesh sieve, showed a marked resistance to rain. Coarser particles of this mixture, however, were much less resistant to the rain. The addition of talc or calcium stearate to this preparation greatly improved its dusting qualities. The talc reduced the rain-resistance of the preparation, whereas the calcium stearate apparently did not.

Mixtures of micronized DDT with calcium stearate also showed marked resistance to rain. Mechanical mixtures appeared equally as good in this respect as those made by use of a solvent, and they were more easily prepared. Material passing a 100-mesh screen appeared about as resistant to rain as that passing a 200-mesh.

Mechanical mixtures of DDT and talc were resistant to the action of rain but not quite so long lasting as preparations containing high proportions of stearic acid or calcium stearate. The latter mixtures, however, did not appear to have sufficiently greater water resistance to warrant the added cost and difficulty of manufacture. Dusts in which the DDT was impregnated on the talc by means of a volatile solvent were not so resistant to rain as the mechanical mixtures.

A brief study was made of the relation between particle size and rain resistance of DDT dust without a diluent. In these tests micronized DDT was effective (80 per cent mortality in 48 hours) through 84 inches of rain. DDT passed through a 200-mesh sieve was effective after only 18 inches of rain, whereas 100- to 200-mesh, and 60- to 100-mesh fractions were toxic through only 12 inches of rain. This indicated that the finer particles of DDT were more resistant to rain.

In the comparative tests of DDT dusts made with talc and with pyrophyllite, four dusts made with talc were effective after 60, 27, 30, and 54 inches of rain, whereas three dusts made with pyrophyllite were effective after 18, 24, and 48 inches. This wide variation with the same diluent depended on the sample used and on the method of milling, the material ground to a finer size apparently being more

TABLE 1. Resistance of fourth-instar larvae of *Anopheles quadrimaculatus* to DDT dusts exposed to artificial rain. Dosage: 0.5 pound of DDT per acre.

| DDT (per cent) | Diluent | Method of Preparation | Number of Tests | Total Inches of Rain After Which Dust Remained Effective |
|---|---|---|---|---|
| 100 | None | Micronized | 2 | 78 |
| 20 | Stearic acid | Volatile solvent; through 200-mesh sieve | 2 | 129 |
| 25 | " " | " " " " | 2 | 39 |
| 33.3 | " " | " " " " | 2 | 63 |
| 50 | " " | " " " " | 2 | 54 |
| 66.6 | " " | " " " " | 1 | 18 |
| 80 | " " | " " " " | 1 | 18 |
| 90 | " " | " " " " | 2 | 18 |
| 20 | " " | Volatile solvent; through 100-mesh sieve | 2 | 51 |
| | " " | Volatile solvent; through 60-mesh sieve | 1 | 48 |
| | " " | Volatile solvent; unscreened | 1 | 12 |
| 10 | Stearic acid 40% plus calcium stearate 50% | Volatile solvent; calcium stearate added by mechanical mixing | 1 | 108[1] |
| | Stearic acid 40% plus talc 50% | Volatile solvent; talc added by mechanical mixing | 1 | 54 |
| 50 | Stearyl alcohol | Volatile solvent; through 200-mesh sieve | 1 | 12 |
| | Glyceryl monostearate | " " " " | 1 | 12 |
| | Cotoflakes | " " " " | 2 | 21 |
| 20 | Calcium stearate | " " " " | 2 | 108 |
| 50 | " " | " " " " | 2 | 54 |
| 90 | " " | " " " " | 2 | 33 |
| 10 | " " | Mechanical mixing; not screened | 2 | 120[2] |
| 50 | " " | " " " " | 2 | 108 |
| 20 | " " | Mechanical mixing; through 200-mesh screen | 2 | 78[2] |
| 50 | " " | " " " " | 2 | 69 |
| 66.6 | " " | " " " " | 1 | 48 |
| 80 | " " | " " " " | 2 | 45 |
| 90 | " " | " " " " | 1 | 24 |
| 95 | " " | " " " " | 2 | 45 |
| 98 | " " | " " " " | 1 | 30 |
| 20 | " " | Mechanical mixing; through 100-mesh sieve | 2 | 78[2] |
| 10 | Zinc stearate | Mechanical mixing; not screened | 2 | 99 |
| 50 | " " | " " " " | 2 | 105 |
| 20 | Copper stearate | Volatile solvent; through 200-mesh sieve | 2 | 57 |
| 50 | " " | " " " " | 1 | 30 |
| 90 | " " | " " " " | 2 | 30 |
| 20 | Talc | Mechanical mixing; not screened | 2 | 90 |
| 50 | " | " " " " | 1 | 96 |
| 10 | " | Volatile solvent; ground but not screened | 2 | 42 |
| 20 | " | " " " " | 2 | 42 |

[1] Test terminated before material became ineffective.
[2] One test terminated before material became ineffective.

resistant. The DDT-talc sample resisting 54 inches of rain was micronized. Although the DDT-talc dusts were slightly superior to the pyrophyllite dusts, the differences were not great and the two diluents may be used interchangeably. In the louse powder recommended for use by the armed forces pyrophyllite was used as a diluent for the DDT (Bushland *et al.* 1945).

*Discussion and Summary.* The first work on DDT dusts for control of anopheline larvae was directed toward the development of products that would not readily be wet and sunk by rain. Dusts containing large proportions of stearic acid or calcium stearate were highly resistant to artificial rain in the laboratory. For use by the armed forces, however, resistance to rain was eventually found to be a factor of comparatively minor importance. A nonwettable dust was subject to wind and wave action, and remained effective for long periods in the field only when the breeding area was protected by thick vegetation. In general, therefore, DDT dusts could only be recommended for control of anopheline larvae for short periods. Dusts using talc as a diluent were therefore recommended as anopheline larvicides for use by the Army and Navy. DDT-talc dusts, although slightly less rain-resistant than those made with stearic acid and calcium stearate, are less difficult to manufacture and may be dusted more readily.

Differences between resistance to rain of talc and pyrophyllite dusts were not great, and for anopheline larvicide purposes the two diluents may be used interchangeably.

*Literature Cited*

BUSHLAND, R. C., L. C. MCALISTER, JR., H. A. JONES, AND G. H. CULPEPPER. 1945. DDT Powder for the Control of Lice Attacking Man. Jour. Econ. Ent. 38(2):210–217.

DEONIER, C. C., AND H. A. JONES. 1944. Insecticide. U. S. Patent 2,349,814.

DEONIER, C. C., J. D. MAPLE, H. A. JONES, E. HINCHEY, AND P. M. EIDE. 1945. DDT as an anopheline larvicide—Laboratory tests. Jour. Econ. Ent. 38(2):241–243.

JONES, H. A., H. J. FLUNO, AND A. B. HENDRICK. 1945. DDT insecticidal preparations. Jour. Econ. Ent. 38(2):207–210.

## "USE OF DDT IN PLAGUE CONTROL AT CASABLANCA"

(Copied from Bulletin of the Army Medical Department, Vol. IV, No. 6 (Dec., 1945), p. 633, as reported by the Tropical Disease Control Division, Surgeon General's Office.)

"Plague was reported as the cause of death of a civilian worker in the port warehouse area of Casablanca, French Morocco, on 21 July 1945, and within a few days several additional civilian cases occurred in the same part of the city. For the protection of American and Italian service units and French military, naval and civilian personnel employed in the area, a meeting was held to plan a program for control of the outbreak. In addition to invoking the international anti-plague measures for ports, restriction of the area to essential personnel, and immunization of individuals likely to be exposed, it was decided to precede the rodent destruction program with applications of DDT in the area to kill any fleas that might leave dead rats.

"A malaria survey detachment experienced in the use of DDT was selected to do the work. A 5 per cent solution of DDT in kerosene was applied with knapsack sprayers to floors and the lower portion of walls in barracks, offices, warehouses, trucks, and two cargo ships moored to the dock. A 10 per cent DDT dust was applied to the clothing of personnel required to enter the area. With a rotary blower, dust was applied to places inaccessible to spray, such as under buildings and in rodent burrows. Local personnel were trained in methods of application of DDT so that they might be prepared to repeat the applications if necessary.

"It is not possible to evaluate accurately the part played by DDT, but, according to latest reports, the plague control program as a whole was completely effective, since no further cases occurred."

# A PRELIMINARY LIST OF MOSQUITOES OCCURRING IN THE VICINITY OF NOME, ALASKA

H. H. STAGE [1] AND E. A. McKINLAY [2]

In July 1944 we tested several insect repellents against the mosquito hordes occurring in the vicinity of Nome, Alaska. In the course of these tests we made observations of the species present and their relative numbers. Again during the summer of 1945 the junior author collected mosquito larvae, bred some out, and sent to Washington for identification [3] larvae and adults taken from that area.

Of the nine species taken during the two seasons, *Aedes nearcticus* Dyar was the most abundant mosquito found, and it was most generally distributed over an 8-mile radius from Nome between the Nome and Snake Rivers.

Except for *Culiseta impatiens* (Walk.), all larvae had emerged before our observations were made in July 1944. In 1945, however, third and fourth instars of *Aedes nearcticus, A. communis* Deg., *A. nigripes* Zett., *A. riparius* Dyar & Knab, and *A. cataphylla* Dyar were taken the first week in June. These species, as well as those taken later, were collected out on the tundra at an altitude of about 200 feet in the characteristic shallow pools of icy cold water. The tundra in the vicinity of Nome is a marshy plain from the seacoast back to the hills and mountains several miles inland. It is characterized by hummocks of moss and bunch grass varying from a few inches to about 20 inches in height. Between these hummocks, pools and little streams of water furnish abundant breeding grounds for mosquitoes. Most of the water comes from the thawing of the subterranean ice and from springs along the hillsides. Everywhere the ground is covered with mosses, lichens, and prostrate plants. Willows are the largest shrubs of this region, and they range in height from 2 or 3 feet across the tundra to 8 or 10 feet along the streams.

After the middle of June 1945, larvae of *A. cinereus* Meig., *A. pullatus* (Coq.), and *A. punctor* (Kirby) were taken less frequently and in fewer numbers. *A. nearcticus* was taken alone and in association with *A. cinereus, A. cataphylla,* and *A. punctor. A. cinereus* was associated with *A. communis* and *A. nearcticus; A. cataphylla* with *A. nearcticus; A. nigripes* with *A. punctor; A. pullatus* with *A. communis;* and *A. punctor* with *A. cinereus, A. nigripes,* and *A. nearcticus.* No *A. riparius* larvae were taken. *Culiseta impatiens* larvae of all stages were taken during July 1944 in pure cultures in temporary rain pools.

As far as we have been able to ascertain, in spite of the great numbers of mosquitoes present, these are the only mosquito records in the immediate vicinity of Nome except for a record of *Aedes punctodes* Dyar by F. Johannsen on August 21, 1916.

[1] Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

[2] Corporal, U. S. Army Medical Corps.

[3] All species were determined by Alan Stone, Bureau of Entomology and Plant Quarantine.

# ASSOCIATION NEWS

## REPORT OF THE MAY 24–25, 1946 MEETING, CONTINUED

The meeting was called to order by Perry W. Ruth, President, who expressed regret that the railway strike had kept away from the meeting so many who would otherwise have been present, including not only several of the scheduled speakers, but also the newly elected President, H. H. Stage, who was scheduled to preside.

Mr. Ruth then in succession asked the First Vice President and Second Vice President to take the Chair; but since both were scheduled to speak, both concurred in asking Mr. Ruth to preside throughout the meeting.

A preliminary report of the meeting, including reports of Committee Chairmen, was published in the June number of MOSQUITO NEWS, together with the statement that a further report of the papers read by discussion leaders and of the discussions which followed would appear in the September number.

Publication of the September number has been somewhat delayed while awaiting copy of papers and of the symposium discussions at these meetings. Delays in the receipt of copy, however, have made it necessary to print here only a part of the proceedings, and to carry over the remainder to the December number. For coherence, therefore, the opening papers and the symposium discussions on "The Importance of Particle Size in Sprays and Aerosol Fogs for Mosquito Control Work," and on the question "Should Mosquito Commissions Be Made Responsible for the Suppression of Other Pests Which May Require Community Action for Their Control?" will be carried over, and only the remaining papers read at the meeting will be printed here.

## THE PAST, PRESENT AND FUTURE OF CHEMICAL MOSQUITO CONTROL

DUNCAN E. LONGWORTH
Nassau County Mosquito Comm.

I do not know who made the discovery that petroleum poured upon the water would kill mosquito larvae, but a review of the literature shows that by the turn of the century this fact was well known. In the control of the yellow fever outbreak in Havana in 1901–1902, "four to six ounces of petroleum poured into the cesspool" did the trick. In the work at Panama under Colonel Gorgas, in the outbreak at Rio de Janeiro in 1903, in Mexico, Japan, Algeria, Ismalia, Italy, India, and other parts of the world, petroleum was being used already as a mosquito larvicide.

Even that early, efforts were being made to improve the oil as a larvicide and the literature shows petroleum was mixed with cresols, lysol, creoline and similar products.

Perhaps we should consider what would be the ideal larvicide. The ultimate would probably be a chemical, within economical reach, which would kill the mosquito larvae within 24 hours, would not harm aquatic vegetation, fish or animals, and one application would last a full season. We might go further and include ovicide and pupicide properties; however, the attainment of the first would accomplish the rest.

That this ideal probably can never be attained is almost an undisputed fact. There are those conditions over which man has little or no control, which, even if such a chemical were discovered, would dissipate it. For instance, the movements of the water, the tides, the rain, and the wind.

In the early 1920s, research turned its thoughts toward the improvement of oils and information began to filter down to the control personnel. While it had been accepted that petroleum merely suffocated the larvae, it was shown that this was true largely of the highly saturated oils (those having hydrocarbons with few or no free bonds), but the unsaturated oils killed through a direct toxic effect on the insect. About the same time more thought was being given to the spreading qualities of the oil, whether it would maintain an unbroken film in the presence of vegetation penetrating the water surface, to the ovicidal and pupicidal effect, to the lasting qualities of one application, and to the repellent effect upon the adult mosquito, so she would not return as quickly to lay more eggs.

This information started the control organizations on a search for commercial cuts of oil which would come the nearest to attaining these results. They were on the whole successful, particularly when the advent of commercial and domestic oil heating became popular and the fuel oils or heating oils most nearly met the desired qualifications. It also sealed the doom of waste crank case or motor oil. Prior to that many organizations had maintained trucks for the purpose of picking up the waste motor oil from service stations, later to use as mosquito oil. The poor spreading qualities of this mixture from cars could not meet the test.

Many petroleum and chemical houses came out with "spreaders," to add to fuel or diesel oil to improve its spreading qualities primarily, but also to increase the toxicity and repellency. Most of these were too costly or experience showed they did not stand up to the claims under field conditions. There were many of these but perhaps the most widely known were special petroleum cuts sold by oil companies, some of the alcohols, pine oil, the cresylics and tar acids. The most widely used today are the cresylics and tar acids. A small amount will improve the spreading quality of fuel oil and some claims of greatly increased toxicity and repellency are made.

One of the most recent of the newer petroleum cuts discovered was the Culicide Oil, in 1939. This is a heavier-than-water oil which, upon application, broke into fine pin-point droplets and fell to the bottom of the water. Sufficient was held on the surface by water tension to kill surface feeding larvae. On the bottom of the water its action seemed to be one of physical contact. A mosquito larva, coming into contact with a droplet, would become attached due to the very sticky nature of the oil, and could not release itself, finally ingesting the droplet in an effort to be rid of it. The toxic qualities of the oil in the stomach of the larva caused its death. This oil gave excellent control for prolonged periods upward of two months in water locations where there was no tidal or stream action. However, the oil was by nature heavy and the mechanical difficulties of spraying it, other than by hand, were not overcome. Also the oil stained clothing and could not be removed.

It was shortly after 1900 that the first attempts to compound larvicides resulted in oils emulsified in water. The first wholesale larvicide so used was the Panama Larvicide. In my personal experiences I was surprised to find in 1944, while stationed at Panama with the U. S. Army, that this same larvicide was still the standard. This Panama Larvicide is made from a heavy black oil, which, in its natural state, is tar-like in its consistency. It must be heated in the process of making it miscible in water. This material is black as coal when sprayed and the damage to vegetation would make it prohibitive for most control organizations to use in this country.

Other attempts at emulsified larvicides included the phenols, which were thought well of in certain sections for a time. Their main claim to fame was that a small concentrated amount could be carried into the field, there to be mixed with water and sprayed. This feature was not suffi-

cient to overcome more important objections of poor toxic qualities and the difficulty the laborer experienced in applying it to the total volume of the water on which it was applied.

Perhaps the most successful of all the miscible larvicides has been the New Jersey Larvicide, a mixture of pyrethrum extract in oil, emulsified in water. The fame of this larvicide need not be dwelt upon here. It arrived at a time when the bird conservationists were blaming all their ills upon mosquito control operations of whatsoever nature, and was the answer to the maiden's prayer. Its ease of compounding, its toxic qualities to larvae without being harmful to fish in the proper amounts, and its concentration, make it an excellent larvicide. Perhaps the chief objections are to the rapid decomposition of the pyrethrins, resulting in loss of toxicity, when applied to such locations as sewage beds, and the fact that a good fuel oil does last a while longer.

Other emulsions have been made with rotenone, chloropicrin, paradichlorobenzine, and fuel oils themselves. While they have made good larvicides, they have not equaled fuel oil in many respects. Chemicals such as borax, alum, copper sulphate and iron sulphate have been employed successfully for control in fire barrels, vats, tubs, and similar containers but their use has been limited thereto.

Dusts have been employed primarily for control of surface feeding larvae, the most famous of which is paris green. This has also been used in a mixture, part of which sank to the bottom of the water in an effort to control sub-surface feeding larvae. Other dusts have been employed but the performance of paris green has made it the standard until now.

The only practical method of controlling the adult mosquito appeared in the form of the New Jersey Pyrethrum Larvicide which was misted over the foliage and gave control for periods of several hours. This was shown to be practical over small areas, such as ball parks, public parks, and similar places, particularly where there was foliage upon which the spray made a barrier.

We now come to the present, the DDT age. Never in the history of insect control has a single chemical brought about such changes in techniques and thinking. The recipient of a billion dollars worth of free advertising, for almost three years it was spoken of in hushed whispers. The secret of secrets, it was discovered in the midst of the greatest conflict man has ever known and everyone who murmured its praises had the thrill of holding hands with the beautiful Mata Hari herself.

We, the control people, are now having to evaluate this chemical genius. It has been proclaimed the cure-all for all the world's insect problems. I prefer to think of it as a new weapon, a powerful one, such as the 50 caliber machine gun which, while a very valuable weapon properly used, by no means replaces all the other instruments of war. This infant prodigy has been left on the doorstep of the control organizations, and with us it has to grow up.

The technicians tell us what this baby will do in the laboratory, and under scietific field conditions. Now we have to put it to work on its own, and it has to perform in the hands of relatively unskilled labor to be economically valuable.

There is no need of my covering the formulae for DDT for varied uses. They can be obtained from many sources. But I do want to point out that today we are in a period of transition. I do not believe the old methods of mosquito control are to be abandoned, but definitely they will be altered. To arbitrarily deny this is to deny facts.

For the first time DDT affords control organizations a practical method of controlling the adult insect. The aerosol, the fog, the mist, the cloud, surrounds us, and we are having a little difficulty seeing the light.

Not only have we this infant DDT in our family, but, like the native African, we have many wives, and each is in labor. The witch-doctor stops around weekly and, in all his mysterious knowledge,

gives us the time, the name of the child, and proclaims its superiority over its brothers and sisters. To say we are tired is putting it mildly. We are walking the floor with 1068, with TDE (or DDD), with 3956, with NR-70, and several others are on their way. We have no recollection of fathering this crop of off-spring, like many other husbands nowadays, we can just blame it on the army.

But what of tomorrow? What is to be the future of mosquito control? Are the old rules to be forgotten? Will control of the adult mosquito supplant larval control? Will drainage be abandoned?

Already we have experiments based on that premise. A few agencies are going all out for aerosol fogs this season. Some of these agencies have heretofore not engaged in any mosquito control work, and are hoping to control mosquitoes and other obnoxious flying insects by this means. Perhaps they will succeed, let us hope so. However, I do not feel that aerosols, either applied by ground or air equipment, are going to be successful as the sole means of control except in relatively small areas, such as along a beach front or around a resort or park of a relatively few acres. Again, nature interrupts man's desires and the aerosol operator will find his control work is dependent upon the wind, rain, and related pranks of the weather. It has been our experience in Nassau County after thirty years of mosquito control that one's plans for control must go on "weather" or no. Airplanes will be grounded for days on end. The rate or direction of the wind will make it impractical to apply aerosols from planes or ground equipment for relatively long periods at the height of the season. Perhaps we will reach the point in development where a single application will apply sufficient residual chemical to control for the whole season. That day has not arrived.

What should be the outlook of an organization like the Nassau County Mosquito Commission? Perhaps I am conservative. I feel the new larvicides and adulticides will be most valuable to us, but, like the 50 caliber machine gun, just another excellent weapon. Mosquito control on a wholesale scale will go on as it has, engaging in drainage and the elimination of breeding to the fullest extent, and the chemical control will still be based on the most vulnerable stage of the mosquitoes' life, the aquatic stage. DDT and the other new chemicals now coming onto the market will render larva control more effective than in the past. The spraying equipment, mechanical and hand, is already being adapted for their use.

The use of aerosols, mists and fine sprays fill in a gap which has long been apparent, a practical method of controlling those broods of mosquitoes which for one reason or another elude the well organized work of the control agency. They will supplement larviciding, and used in aeroplane or ground equipment will permit the spraying or fogging of large open marshes which has been impractical heretofore.

Maybe my conclusions are wrong, the picture is changing daily and that change may continue until we will hardly recognize what used to be. When that time comes, I am all for it, and from where I sit, I am looking through conservative glasses.

# A RESUME OF THE PAPERS PRESENTED AT THE ANNUAL MEETING OF THE FLORIDA ANTI-MOSQUITO ASSOCIATION

DUKE PETERS

The last meeting was held in 1942. The following years the meetings were abandoned because of the curtailment of civilian travel and also the shortage of hotel accommodations. A great many of our Directors were in service and not available. The information on mosquito control was changing so fast in that period that we felt we would like to wait until they got back. Our recent meeting bore out our judgment because we did have an excellent meeting from the standpoint of interest of those present as well as information given.

The opening day, after the usual invocations, addresses and responses, our first paper was presented by our President, Mr. Ruth. Perry spoke on the assets of organization. The paper was very well received and out of that you will have a great many more members from the Florida group.

Mr. Lindquist of the Agricultural Research Information Bureau gave some facts on recent developments in salt marshes. His paper provoked a great deal of discussion and he was very capable in replying to these questions.

Among the most interesting things were the reports of the existing mosquito control districts during this wartime period. Conditions had changed fast and there was much questionable work being done during that period; but from these reports we found that the boys were still working and keeping up with current affairs to the extent that rather than lose ground during this period we gained ground.

Mr. Dorer told us some facts about Virginia. That to us was very interesting because when you go into mosquito control work you tell about some of your own experiences.

As you might expect, our program dealt largely with DDT. We had not had a meeting since before DDT came into common use and the whole theme of the meeting was DDT. Before the war most of our efforts were expended toward controlling mosquitoes in the larval stages. Now we are about to forget about that and are working on adults. There were men there who had considerable war experience. They brought to us the types of work done overseas in the different areas and the mosquito control work that was done in actual combat. They told at length of the work they had done and the significance the work has in our future program.

On the other side of the picture, we had a paper from the Executive Vice President of the Florida State Chamber of Commerce. His theme was coordination and promotion of mosquito control efforts in Florida. He brought to us the enthusiasm and the cooperation of the State Chamber of Commerce and their desire to assist in any way possible in the promotion of mosquito and sand fly control work in Florida. He said that any time we wanted publicity or any laws changed they will take care of the ground work. That to us was one of the things we had been working for for many years, to get statewide appreciation and support.

The Army and the Navy were not overlooked. Some Navy personnel explained airplane treatment.

Another panel discussion was put on by the returned veterans who were in air control work. These fellows expect to carry on a great deal of our work from now on. The information they learned can be converted to our peacetime uses.

The last day of the meeting was rather interesting as the Agricultural Research Administration, Bureau of Entomology and Plant Quarantine, USDA, Orlando, came up with lots of equipment and per-

sonnel. They not only explained the use of their equipment but actually demonstrated it. Took it to the airport and demonstrated uses of equipment and something of the reason for building up the type of equipment.

I have given the highlights of our meeting and in conclusion I want to extend an invitation to all of you to come down. If we can't tell you anything about mosquitoes we can at least show you what we have and make an attempt to show you something interesting while you are down there.

# POSSIBLE UTILIZATION OF THE NEWLY DEVELOPED AEROSOL METHODS IN APPLYING THE NEW JERSEY MOSQUITO LARVICIDE FOR OUTDOOR PROTECTION FROM ADULT MOSQUITOES *

J. M. GINSBURG

Rutgers University, Agricultural Experiment Station, New Brunswick, New Jersey

Even in areas where mosquito control work has been systematically conducted for many years it has not been possible with our present means and methods completely to eradicate the mosquito. Under conditions favorable for its rapid development, such as during summers of abundant rainfall, the mosquito seriously interferes at times with human comfort. Of course, under otherwise similar conditions, the discomfort is much worse in areas where no mosquito control extermination work is carried out than in areas where control work is in operation. Complete elimination of mosquitoes indoors can be readily accomplished by proper screening, spraying or fumigating. On the other hand, protection from mosquito annoyance outdoors constitutes a difficult problem.

During the last 12 years an oil pyrethrum emulsion which became known as the New Jersey (2, 3, 4) Mosquito Larvicide, proved an effective spray in protecting outdoor audiences from mosquito annoyance. It has the following composition: 66 per cent kerosene or similar light petroleum distillate; 0.07 per cent pyrethrins (equivalent to extract of 1 pound of flowers, analyzing 0.9 per cent pyrethrins, per gallon of kerosene); 33.5 per cent water; and 0.5 per cent of a neutral emulsifier, such as commercial sodium lauryl sulfate. The concentrated larvicide is diluted with 10–12 parts of water and sprayed on the area where the gathering takes place. In this case the larvicide performs two functions. It prevents outside mosquitoes from coming into the protected area while the adult mosquitoes within the sprayed area are either killed or paralyzed to such a degree that for several hours they remain inactive. When sprayed as directed, the larvicide causes no injury to grass, shrubs, trees, ornamental plants, man and higher animals. Since 1935, when this spray was first introduced, numerous outdoor evening concerts, carnivals, church parties, community gatherings, lawn parties, and similar small and large groups of people have been protected from mosquitoes. Extensive experiments conducted by the

* Journal Series paper of the New Jersey Agricultural Experiment Station, Rutgers University, Department of Entomology.

writer in cooperation with the County Mosquito Extermination Commissions in New Jersey have established a definite method of procedure for spraying, which is here briefly described.

*Directions for Applying the New Jersey Mosquito Larvicide*

The concentrated larvicide is first well shaken or stirred. It is then mixed with 12 parts of water (1 quart to 3 gallons) in the sprayer. This diluted mixture is ready for spraying. During the spraying operation it should be frequently shaken or stirred to ensure uniform distribution of the larvicide.

*Procedure.*—Before the affair starts, the entire area including grass, shrubs, bleachers, sheds, benches, or any other place where mosquitoes may rest during the day is thoroughly sprayed with the diluted larvicide. This should kill or incapacitate all mosquitoes hiding within the area. The next objective is to prevent outside mosquitoes from coming into the protected area. For this purpose the spray is directed upward so as to saturate the atmosphere with a fine mist or fog of the larvicide. The spray is best applied against the wind so that the fine mist or fog will drift with the wind throughout the area. Just about dusk or when the mosquitoes from the outside begin to fly in, the fogging operation is repeated, the spray being applied as high as the pressure of the sprayer permits, preferably on the side from which the wind is blowing. If no noticeable wind prevails it may be necessary to fog all around the area, directing the spray upward so as to keep the inflying mosquitoes away. One thorough fogging at this time is generally sufficient for the rest of the evening. Under very heavy infestations where the mosquitoes are coming in large numbers, another fogging about 9 P.M. may be necessary. The operator in charge should be on the alert for this last step.

The main principle of this procedure consists of saturating the atmosphere with a fine mist or fog of larvicide. The longer the spray remains in the air, the longer its lasting protection. Of course, the finer the size of the dispersed droplet, the slower will be its rate of settling. The most efficient results are obtained when a high pressure power sprayer is used. The application by power sprayer is rather slow and requires a large volume of liquid, which is an objectionable feature in the operation.

*Aerosol Sprays*

Now, the newly developed methods for dispersing aerosol sprays in extremely fine particles over large areas may offer a more efficient, less costly, and less cumbersome mechanism than the power sprayer. The term "aerosol," is employed in colloid chemistry (1, 9) to designate a dispersion of fine, solid or liquid particles in air or any other gaseous medium. Aerosols include a variety of natural and artificial systems, such as smoke, clouds, mist, fog, fumes, atomized oil in oil burners, and smoke-screens in chemical warfare, in which air constitutes the continuous external phase or the dispersion medium and the fine particles form the internal or dispersed phase.

The main object of aerosol spraying is to disperse concentrated (6) insecticides, mosquito larvicides (5), repellents, etc., in such a fine state of subdivision and in such a way that they remain suspended or floating in the air for long periods of time, thereby prolonging their effectiveness. The particle size may vary from a fraction of a micron (1/25,000 of an inch) to many microns in diameter. The particles of the dispersed phase tend to coalesce and settle downward. The rate of settling will vary with the density, viscosity, size and electrical charge of the dispersed particles (8), and the nature of the dispersion medium. Strongly charged particles prevent aggregation by mutually repelling each other and thus retard settling. The presence, in the dispersion medium of "nuclei" such as smoke, dust, and salts, on which particles of the dispersed phase condense may also retard

settling by presenting coalescence into large aggregates. All other conditions being equal the smaller the particle size, the longer it will remain suspended in air. Thus, the advantage of aerosols over coarse sprays lies primarily in the performance of fine particles. The range of fineness of oil-pyrethrum particles for optimum toxicity and repellency to adult mosquitoes has not been definitely determined and offers an interesting field for research.

Several methods are now in practice for producing aerosol sprays from concentrated insecticides such as:

1. Volatilization from a liquefied gas (7), containing the toxicant in solution. (Army aerosol "Bomb.")

2. Dispersion by high velocity wind produced by suitable fans, propellers, etc. (Buffalo Turbine, "Speed" Sprayer.)

3. Electric atomizers.

4. Heat-generated aerosols. Many devices are used, varying from a small hot plate from which the insecticide is volatilized, to the complex fog-machines, modified from the army screening smoke generator.

In this last group, the fog-generator, of which three models are at present available (Todd, LaMer, Besler), may offer a substitute for the power sprayer. In each of the three models mechanisms have been adjusted for regulating particle size and volume of liquid deposited from concentrated insecticides. Such a machine, if proved efficient, may possess the following advantages over the power sprayer:

1. Reduction in volume of spray. A small quantity of concentrated larvicide or pyrethrum extract may replace the large amount of diluted spray.

2. Speed of operation. A large area can be quickly covered several times, if necessary, within a short time.

3. Saving in labor. One man can perform the entire operation, whereas three men are generally required to apply the larvicide by power sprayer.

4. Saving in space. The fog machine can be placed on a small delivery truck and still leave enough space for one or more small drums of the concentrated larvicide.

Preliminary tests and observations made by the writer with the Todd fog generator during 1945 warrant further experiments with this or similar aerosol generators with the object of simplifying our present method of protecting outdoor gatherings from the mosquito annoyance.

*Literature Cited*


1. ALEXANDER, J. 1937. Colloid Chemistry. Principles and applications. D. Van Nostrand Company, New York.
2. GINSBURG, J. M. 1930. Studies of Pyrethrum as a Mosquito Larvicide. Proceed. 17th Annual Meeting, New Jersey Mosquito Extermination Association, pp. 57–72.
3. ———. 1937. Principles Underlying the Protection of Outdoor Meetings from the Mosquito Pest and Methods of Application. Proceedings 24th Annual Meeting New Jersey Mosquito Extermination Association, pp. 5–11.
4. ———. 1939. New Jersey Mosquito Larvicide. New Jersey Agricultural Experiment Station Circular 382.
5. ———. 1943. Aerosol Sprays for Killing and Repelling Mosquitoes. Proceedings 30th Annual Meeting. New Jersey Mosquito Extermination Association, pp. 211–17.
6. SCHRAEDER, H. O., A. H. MADDEN, A. W. LINDQUIST AND H. A. JONES. 1946. Concentrated Sprays, Soap and Sanitary Chemicals. 22(3):145–47.
7. SULLIVAN, W. N., L. D. GOODHUE, AND J. H. FALES. 1942. Toxicity to Adult Mosquitoes of Aerosols Produced by Spraying Solutions of Insecticides in Liquefied Gas. Jour. Econ. Ent. 35(1):48.
8. WEISER, H. B. 1939. Colloid Chemistry. John Wiley & Sons, New York.

# GROUND SPRAYING EQUIPMENT

RAY H. SAMMIS
Superintendent, Nassau County Mosquito Comm.

Let us start our discussion of ground spraying equipment with a short review of equipment used in the past. The evolution of this equipment has led to what we are using today. Since the improvement in spraying equipment is dependent upon the chemicals used, the subject will have to be discussed under two separate groups; first, the mechanical means of ground spraying; second, the different kinds of chemicals to be applied.

In 1912 we used sprinkling pots, and believe it or not, an ordinary house broom to brush on the oil, which method is still used in India, Africa, and other parts of the world. The means of transportation were bicycle and horse and wagon.

A little later we modernized our methods by using knapsack sprayers and stirrup pumps, and traveled around in auto trucks made from converted passenger cars. These trucks caused many hours of grief, but were the beginning of real progress in the development of ground spraying. The trucks were structurally weak and poorly designed for the use to which they were put and something better was desired.

By 1920 it was possible to buy commercial vehicles which, for the time being, met transportation requirements. It was at that time that cylindrical tanks were mounted on the trucks and partly filled with fuel oil. Charged with compressed air and a short hose attached, they constituted the first mechanical catch basin spraying units. This proved such an improvement over the sprinkling pot method, that it led, in 1926, to the installation of a rotary pump mounted on the running board of a truck carrying a larvicide tank. Up to this time the greatest pressure we could generate with the stirrup pumps was about 60 pounds, but this equipment gave us working pressures up to 150 pounds. This made finer sprays, more even distribution and greater coverage of larvicides.

This success led to the desire to have a vehicle which could travel in the soft ground in marshy areas. A small truck equipped with track laying tread enabled us to approach nearer some hitherto inaccessible spots. This conversion was far from the ideal answer but it was progress.

The next step was the installation of a plunger type pump driven by a power takeoff, capable of generating from 300 to 400 pounds working pressure. This permitted longer hoses and 300 feet became the standard although more was used on occasions. Improved nozzles added to the value of this equipment. This was a great stride in the field of ground spraying equipment, and is still the standard. What we did was adapt orchard spraying equipment to mosquito control. This was developed for larval control, using oil and different emulsions. The same plunger type pump, with its high pressure, made possible the first experiments in mist or fog spraying of pyrethrum emulsions for the control of adult mosquitoes.

Then with the development of the two axle drive truck the nightmare of having the spray rigs bogged down at frequent intervals in soft ground was solved. It is now possible to use mechanical sprays in nearly any place we wish.

So much for the past history of ground spraying. The thought for today includes control of the adult mosquito by means of aerosols in addition to control of the larvae. DDT and other new chemicals necessitate the adaptation of old machines and the invention of new types for the procedures involved in using them as larvicides and insecticides.

As the new formulas are brought out, new equipment is being developed for

the most effective and economical means of dispersal. Different types of machinery are required for the control of larvae from that needed for control of the adult mosquito. What will be the equipment of tomorrow? I think the high pressure plunger type pump, modified with mist nozzles, will still be used for many of the formulas, but with some changes in the technique of the spray man. Several machines are already on the market for the application of aerosols. One type generates an oil vapor or aerosol fog. Still another machine is so designed that it can blow either a liquid mist, a dust application or a combination of the two. Since aerosols and mists or fine sprays depend upon the wind for their transportation, all of this equipment must be used on the windward side and the vapors allowed to drift across the area being controlled.

So long as we have new chemicals requiring new techniques of application, we will need new equipment or adaptations of the old to achieve their advantages in mosquito control work. The paper that follows will discuss the different larvicides and insecticides that have been and are to be used in these mechanical units.

# DDT, TIFA, AND THE POLIO EPIDEMIC AT SAN ANTONIO, TEXAS

FRANK K. STEINROCK

Todd Shipyards Combustion Equipment Division

*Pres. Ruth:* I am sure we shall all be interested in hearing a report from Mr. Frank K. Steinrock relating to the current outbreak of poliomyelitis at San Antonio, Texas, and to special measures employed in the hope that they might help to relieve the situation.

*Mr. Steinrock:* You have all read of the current polio epidemic in San Antonio, Texas. A week ago yesterday about 2 o'clock in the afternoon, I had a call from the Director of the City of San Antonio Department of Health. His call was urgent. He said, "You have probably read that we have a terrific polio epidemic in San Antonio. What can you do to help us?" "Frankly," I said, "I don't know a thing that I can do; I'm *not* a doctor; I don't know anything about polio; and I don't know anyone who does. At best, I am only a sort of half-way mechanic." The director said, "Our doctors have come to the conclusion, even if it is not a complete conclusion, that the polio was brought to San Antonio by a tropical mosquito and that it is being transmitted by insects such as mosquitoes or houseflies, and the like. We have read, of course, of the fine work that your TIFA has done at Jones Beach and elsewhere, and wonder if it could not help us."

I said, "If you are willing to start at that point and use that as a definite conclusion, I, as a mechanic, can tell you what I would do if I were in your position; and if you like, we will try to help you."

I told him that I had been privileged to participate in, and had personally observed the use of our TIFA in experiments carried on by the scientific research personnel of various state agencies and I knew that DDT, properly applied, will kill mosquitoes, houseflies, stable flies and various other dangerous and annoying in-

sects. I recommended that inasmuch as they had planes already on hand, and had done some spraying and some dusting from the air, that they encircle the city by a protective zone sprayed or dusted with DDT according to equipment that might be available. I also suggested that they call in from the neighboring ranches as many spray rigs and spray operators as they could get, and with these spray rigs they treat their dirty spots such as garbage dumps, stables, etc., and with their Health Department knapsack crews that they treat places which could not be reached effectively by the spray rigs or from the air. I suggested that when TIFA arrived they pick the spots—the houses—where polio cases had occurred, and fog thoroughly the area for several blocks about such houses. Then at night, when the fog would not interfere with traffic or with business, to work the downtown and congested areas; and later, after that was done, to go over the entire city, which meant covering approximately 1,000 miles of streets.

After about 45 minutes of discussion the health officer seemed to have but one problem left—how to get TIFA to San Antonio, and quickly. We had offered the use of a unit, together with an experienced technician and mechanic. He asked for a short time to enlist transportation help, and at 4 o'clock he called back to tell me that a plane would be at the Newark airport at 7 to take TIFA and the men specially and directly to San Antonio.

We dropped all other business at hand and the machine and men were loaded on the plane on time—all soaked by a terrific thunderstorm, and too hurried even for supper. Upon arrival the next morning at San Antonio, the program outlined by phone was immediately got under way. Yesterday I had a phone call from our men, who are now stranded in San Antonio on account of the railroad strike. They have trained three or four local crews; and TIFA is working, and will continue to work 24 hours a day until the situation is improved. Results have shown that they were able to run the machine through the city streets and do what appeared to be an effective coverage at the rate of 10 miles an hour. Even at 10 miles an hour it will require 100 hours to get over all of the city streets.

While a general application of DDT may not prove to be the answer to the polio epidemic, the obvious effort to do something about it must have real psychological value in combating the panic which is likely to appear in a situation of this kind; and the general elimination of mosquitoes and flies which such use of DDT is sure to bring about, should be very much worthwhile in itself through reduction of other diseases known to be carried by these insects.

I might conclude by calling attention to the fact that the use of planes, power sprayers, knapsack sprayers, and TIFA illustrates a point which I have often made—that a good mechanic will not try to do all of his work with a single tool, but that he will equip himself with a full kit of tools suitable for any job that may come along.

San Antonio reports that the rapidly rising number of new cases has turned downward. I hope, and we all hope that the epidemic may soon be stopped.

What finally comes from the San Antonio experiment you folks will read in your daily papers, and in your scientific magazines.

## MORE ABOUT THE POLIO EPIDEMIC AT SAN ANTONIO, TEXAS

As the September number was going to press, photostat copies of the following correspondence came to the editor's desk. While the fogging experiments were not carried out with any scientifically rigorous checks, these comments by the public health officers concerned, and particularly the graph showing such an abrupt drop in the number of cases following the use of DDT in the manner described, occurring so much earlier in the season than polio epidemics usually subside, make this later material so aptly supplemental to Mr. Steinrock's report and seemingly so significant and of such general interest, that space was made for it in this number.—Editor's note.

**Todd Shipyards Corporation**

NEW YORK OFFICE. 1 BROADWAY - TELEPHONE DIGBY 4-6900 - CABLE "ROBIN" NEW YORK

PLEASE ADDRESS YOUR REPLY TO
TODD SHIPYARDS CORPORATION
(COMBUSTION EQUIPMENT DIVISION)
601 West 26th Street
New York 1, N. Y.
BRyant 9-4725

TODD SHIPYARDS CORPORATION
BROOKLYN DIVISION:
Foot of Dwight St.
Brooklyn 31, N. Y.
CUmberland 6-6820

TODD SHIPYARDS CORPORATION
(HOBOKEN DIVISION)
Park Ave. & 17th St.
Hoboken, N. J.
HOboken 3-0700

TODD SHIPYARDS CORPORATION
(SEATTLE DIVISION)
Seattle 4, Wash.

TODD MOBILE DRY DOCKS INC.
Mobile, Ala.

TODD GALVESTON DRY DOCKS INC.
Galveston, Texas

TODD HOUSTON SHIPBUILDING CORP.
Houston 1, Texas

TODD PACIFIC SHIPYARDS INC
Seattle 14, Wash.
Tacoma 1, Wash.
San Pedro, Cal.

SOUTH PORTLAND DRY DOCK AND REPAIR COMPANY
South Portland 7, Me.

*Affiliated Companies*

TODD-JOHNSON DRY DOCKS INC.
New Orleans 3, La.

NEW ENGLAND SHIPBUILDING CORP.
South Portland 7, Me.

TODD-BATH IRON SHIPBUILDING CORP
South Portland 7, Me.

WE CONTRACT ONLY UPON THE FOLLOWING TERMS APPLICABLE TO EVERY CONTRACT ALL CONTRACTS ARE SUBJECT TO STRIKE RESTRICTIONS AND FORCE MAJEURE OUR DUTY IN CASE OF STRIKE LABOR DIFFICULTIES FIRE OR CAUSES BEYOND OUR CONTROL OUR LIABILITY IN CASE OF DEFECTIVE WORKMANSHIP OR MATERIAL IS LIMITED BY LAW TO THE PROPER REPLACEMENT THEREOF

FURTHERMORE WE UNDERTAKE TO PERFORM WORK HEREUNDER ONLY UPON CONDITION THAT WE SHALL NOT BE LIABLE IN ANY WAY FOR ANY PROPERTY REAL OR PERSONAL OF ANY OWNER PURCHASER LESSEE OR HELPER OR AND SETTLE IN CONTRACT TORT OR OTHERWISE FOR ANY LOSS OR DAMAGE TO ANY SUCH PROPERTY OR FOR ANY INTEREST THEREIN WHATSOEVER FOR LOSS OF USE OR ANY OTHER PERSON CLAIMING ANY CONSEQUENTIAL THEREOF UNLESS SUCH LOSS OR DAMAGE TO SUCH PROPERTY OR FOR SUCH LOSS OF USE RESULTS FROM THE WILFUL ACT OR NEGLECT OF OUR EMPLOYEES AND IN NO EVENT SHALL OUR AGGREGATE LIABILITY TO ALL SUCH PERSONS AS A RESULT OF SUCH ACTS OR NEGLECT EXCEED THE SUM OF $1,000.00

IN CONNECTION WITH THE ACT, DEBT AND OR INDEMNITY AND OR INSURANCE PERSONAL PROPERTY REAL OR PERSONAL. YOUR OR PLEASE NOTICE THAT WE CAN AND BELONG TO LIABILITY FOR AS THEY UNDERTAKE TO IMPOSE ANY LIABILITY OR OBLIGATION UPON US TO INSURE OR MAINTAIN INSURANCE BEYOND THE LIABILITY OR OR THE OBLIGATIONS TO INSURE IMPOSED UPON US BY LAW

Subject: "TCDD" Insecticidal Fog Applicator
"TIFA"

Dr. Robert D. Glasgow, State Entomologist,
The University of the State of New York,
State Geological and Natural History Surveys,
Albany 1, New York

Dear Doctor Glasgow:

In response to your wish expressed over the telephone yesterday afternoon, we are pleased to send herewith the original letters and data, relative to the San Antonio, Texas poliomyelitis epidemic.

We are following your advice, and sending them via registered mail.

Very truly yours,

TODD SHIPYARDS CORPORATION
(COMBUSTION EQUIPMENT DIVISION)

NMcDonald:EWS
Encl.
Reg. R.R.R.

FORM 70.

**TODD SHIPYARDS CORPORATION**
*and Subsidiaries*

**INTEROFFICE CORRESPONDENCE**

| | | | |
|---|---|---|---|
| *FROM:* | Mr. Norman McDonald | PLANT: | |
| *TO:* | Mr. Frank Steinrock | PLANT: | |
| *Re:* | "TIFA"<br>SAN ANTONIO POLIO EPIDEMIC | DATE | August 6, 1946. |

I called Mr. H. L. Crittenden of the San Antonio Health Department and asked how the "TIFA" fog machine had performed for them in combating Polio.

He was most enthusiastic, and said, "It was an answer to our prayer" "It stopped an incipient epidemic in its tracks before it could reach its normal height". I asked him if he really felt that the fogging had reduced the number of cases and he said - "Unquestionably". Moreover, he said that the job just could not have been done in any other way because of the cost element. Our fogging method he feels is over 90 times cheaper. As an example he pointed out that previously they sent a crew of six men with spray equipment to do four square blocks around a polio case and this took almost one day.

This is not as yet the time when polio ordinarily reaches its climax; yet at the present time, the number of cases are gradually dropping off to many less than in the past year and this in spite of an extremely early start. In fact, at present, all bans have been lifted.

Dr. T. Phany, Director of Public Health at Laurel, Mississippi, wrote and asked Dr. Marvel Dir of San Antonio, Public Health Department if he had to go through this critical period again what would be his method of control. Mr. Crittenden reports that Dr. Marvel wrote that fogging would again be the method.

The Pueblo, Colorado Health Department also wrote Mr. Crittenden in regard to the same problem, and specifically inquired about "TIFA". A similar letter was sent to them.

Copies of both these letters will be in the mail today.

NMcDonald:st

COMMISSIONERS
GUS B. MAUERMANN, MAYOR
P. L. ANDERSON, COMMISSIONER OF FIRE AND POLICE
ALFRED CALLAGHAN, COMMISSIONER OF TAXATION
HENRY F. HEIN, COMMISSIONER OF SANITATION, PARKS AND PUBLIC PROPERTY
PAUL E. STEFFLER, COMMISSIONER OF STREETS AND PUBLIC IMPROVEMENTS

LEWIS C. ROBBINS, M. D., M. P. H.
DIRECTOR OF PUBLIC HEALTH

**City of San Antonio**
HEALTH DEPARTMENT

128 WEST COMMERCE STREET
SAN ANTONIO 5, TEXAS
August 6, 1946

BOARD OF HEALTH
PAT I. NIXON, M. D., CHAIRMAN
E. A. BAETZ, VICE-CHAIRMAN
E. V. DePEW, M. D., SECRETARY
MRS. LEROY G. DENMAN
NAT GOLDSMITH
REAGAN HOUSTON
CARL KRUEGER
GUS B. MAUERMANN, EX-OFFICIO
MAYOR CITY OF SAN ANTONIO

PHONE F-4361

Todd Shipyards Corporation
(Combustion Equipment Division)
1 Broadway
New York, New York

ATTENTION: Mr. N. M. McDonald

My dear Mr. McDonald:

In accordance with our understanding when your Corporation so generously loaned the Tifa machine in our polio emergency, I am enclosing correspondence in lieu of our sending a report to you on our opinion of the efficacy of the machine and reasons for our desiring to purchase it. This seems to me to be the best method to demonstrate our real and sincere opinions.

We certainly believe that to the extent flies, mosquitoes and other insects spread disease germs to humans, the Tifa fogging machine should be given the major credit as far as equipment is concerned, for reducing the incidence of disease here this summer, particularly "polio".

Incidentally, we have been advised by the representatives of the gasoline motor here to use white gasoline on account of the daytime temperature in summer.

Trusting that the material enclosed, in so far as it represents a health department's considerations, will be helpful to you, I am

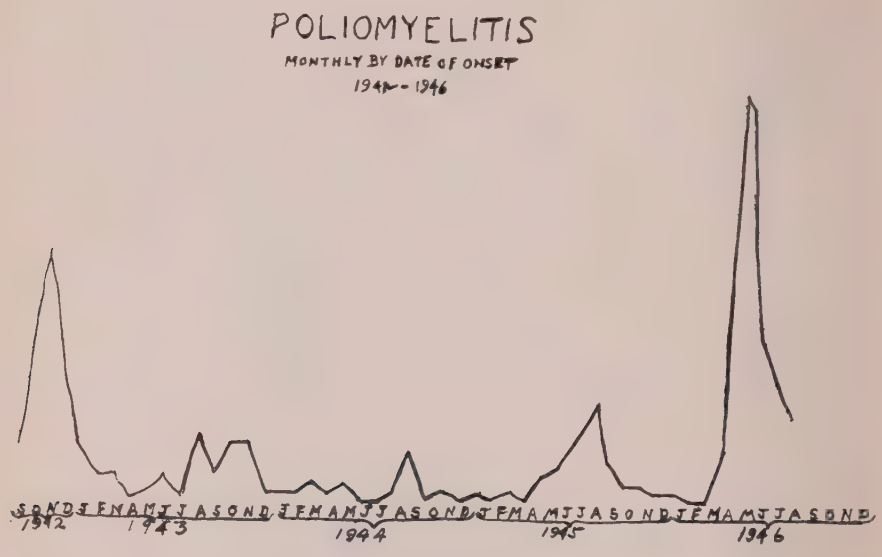
Sincerely yours,

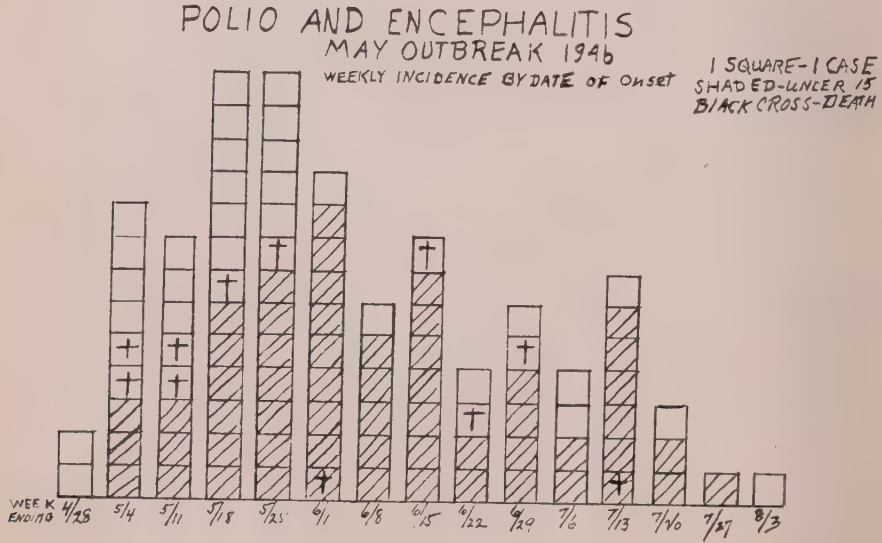
H. L. Crittenden
Administrative Assistant

The following graphs hastily drawn in pencil were accompanied by a penciled memo as follows:

## SAN ANTONIO HEALTH DEPARTMENT
## INTER-DIVISION MEMOS

"Please excuse juvenile work; but I wanted to have this get to you with other materials. Do they give you figures you wanted?"


POLIOMYELITIS
MONTHLY BY DATE OF ONSET
1942 - 1946
SONDJFMAMJJASONDJFMAMJJASONDJFMAMJJASONDJFMAMJJASOND
1942
1943
1944
1945
1946


POLIO AND ENCEPHALITIS
MAY OUTBREAK 1946
WEEKLY INCIDENCE BY DATE OF ONSET
1 SQUARE - 1 CASE
SHADED - UNDER 15
BLACK CROSS - DEATH
WEEK ENDING
4/28
5/4
5/11
5/18
5/25
6/1
6/8
6/15
6/22
6/29
7/6
7/13
7/20
7/27
8/3

San Antonio, Texas
May 22, 1946

Mr. R. W. Bowes, President
C/o Todd Combustion Equipment
601 West 26th. Street
New York City, New York

Dear Mr. Bowes:

Speaking for the City Health Department, as well as the public, we are deeply grateful for your assistance in our campaign against polio. Your Mr. Steinrock has been most generous and cooperative in lending the machine to San Antonio for this purpose. Mr. M. McDonold and his Engineer, Mr. Linen have been very representative of your company and their advice and aid have been most beneficial.

We understand that we are the first city to use all known forms of weapons against various vectors of diseases in the same operations, namely; sprayers, both hand and power; dusters, both air-borne and land; and the fog applicator.

Our program has been thoughtfully outlined and prepared and your amazing fog generator with its ability to cover thoroughly and economically the desired areas in a minimum length of time is most gratifying and amazing. I know of no other way of having been able to cover the business district when aeroplane dusting is prohibited and I stood astonished as I saw the fog climb the side of those buildings as it struck the building at a lower level.

Please accept my personal thanks as Supervisor of the spraying program.

Respectfully,

James S. Kilgore

James S. Kilgore

COPY COPY

HEALTH DEPARTMENT

CITY OF PUEBLO

Bert. L. Beaty
Commissioner of Health

W. E. Buck, M.D.
Chief of Department

Frances M. Henigsman
Chief Clerk

PUEBLO, COLORADO

July 29, 1946

Health Officer
City of San Antonio
San Antonio, Texas

Dear Sir:

I understand that San Antonio has done a great deal of DDT spraying because of the Polio epidemic. We are having a few cases of the disease here, in fact we have five cases so far in Pueblo, and of course, we want to do everything we can, not only to control Polio, but to get rid of the flies if we can possibly do so.

May I ask you to give us a little detail of what you did, what spray or strength of spray you used, how and where. Also, the results as far as the elimination of flies was concerned and whether or not you think it did anything to help control Polio or any other diseases. With the experience you have already had, what would you do again under similar circumstances.

Thanking you for an early reply, I beg to remain,

Yours very truly,

DEPARTMENT OF HEALTH,
INSPECTION & SANITATION
(signed)
W. E. Buck, M. D., Chief

WEB/h
Enc.

July 31, 1946

W. E. Buck, M. D., Chief
Department of Health
Inspection & Sanitation
City Hall
Pueblo, Colorado

Dear Sir:

This is in reply to your inquiry of July 29, regarding control measures used in our polio epidemic. We shall endeavor to briefly answer your questions and give you an idea of the procedures which were followed.

The outbreak was rather explosive in nature with a mortality of 50%. Of course, this high mortality rate did not continue but it did serve to shock our city and arouse everyone to immediate action. Our first efforts at control, in addition to general clean-up efforts and special drive for covered garbage containers, was in the nature of spraying operations. Both power and pressure hand sprayers were used at this stage of our campaign. A DDT concentrate in xylene and trito. of about 25% strength was used. This was diluted with water to 7%. A considerable area around each case was treated in this manner.

After the first wave of hysteria wore off and we were enabled to collect ourselves and more carefully make out our approach, the spraying procedure was somewhat changed and other control measures instituted. Power spraying was used only on creeks and ditches and this was later abandoned altogether. Spraying was inaugurated and is still being carried on at the various garbage dumps and sanitary fills. Garbage trucks upon being emptied are also sprayed before being returned to the city. A 5% DDT solution in kerosene is used for this purpose.

Since we have considerable areas where sanitary sewers are not available, it follows that we have a large number of pit toilets. Larvaciding of these pits was begun as a measure towards fly control. Because we desired for the public to take over this operation and carry on their own larvaciding operations, we decided to make it as simple as possible. Therefore only straight kerosene was used in this operation, and its continued use has been requested of the individual householders.

W. E. Buck, M. D. - 2 - July 31, 1946

After we had been in our polio campaign for something like two or three weeks, the Todd Ship Building Corporation made available to us one of their fogging machines. This machine blankets an area with about 10% DDT fog. Kerosene is vaporized in order to create this fog. While the residual thus created is not heavy, it does have some lasting effect, and has the redeeming feature of being mobile and rather rapid in coverage. It is operated from a truck. We subsequently purchased this machine and are now using it for all case area control, and, in fact, for all city-wide fogging operations.

The above efforts resulted in a remarkable reduction in the number of flies. While flies are not 100% eliminated, they are rendered very, very scarce. It is our belief that the rather wholesale elimination of insects, such as flies and mosquitoes, not only aided in the campaign towards polio control, but that it has also reflected a reduction in the number of cases of infant diarrhea. We have also experienced - - at least up to this date - - a reduction in the incidence of typhus but we cannot be so definitely assured that our current campaign against polio had been reflected in our trouble with typhus.

You asked the question, "With the experience you have already had, what would you do again under similar circumstances?" We would concentrate on two things - - city-wide fogging operations and especially efforts towards fly control. These special efforts would be, specifically, garbage control and larvaciding of pit toilets. It is our belief that those measures would serve to reduce the insect population.

In addition to the above information as to control measures, other things incidental to the campaign might be worthy of mention. Due to the excitement, this office was flooded with hundreds of complaints. As is usually the case, many of these had no connection with public health and were rather trival in nature. We processed these to the best of our ability, and, of course, did succeed in the elimination of many health hazards. The pressure of the campaign and of public opinion, naturally enabled us to accomplish things which would have been very difficult under ordinary circumstances. One of the most profitable by-products of the campaign developed in the form of a house-to-house or premise-to-premise inspection service. We developed and still have operating a crew of 16 men who operate as a unit. A block is cleaned up before proceeding to the next block. Of course, several blocks are covered each day. In fact, the number of premises inspected daily will run from 800 to 950. We have now covered a number of about 35,000 premises. Five points are included in this survey sheet. A copy of it is herewith inclosed.

It might interest you to know that the ban on public gatherings which was proclaimed at the beginning of the polio campaign in May has just been lifted as of July 29.

W. E. Buck, M. D. - 3- July 31, 1946

We trust this will give you the information desired. Should there be anything further, do not hesitate to write us.

Very truly yours,

R. L. Marvel, Chief
Environmental Sanitation

Approved:
E. J. Arendt, M. D.
Acting City Health Officer

August 6, 1946

Dr. T. P. Haney
Director of Public Health
Laurel, Mississippi

Dear Sir:

Dr. E. J. Arendt, Acting City Health Officer, has asked me to write to you concerning cost of our DDT operations and the equipment we used, particularly the Tifa fogging machine manufactured by Todd Shipyards Corporation.

Background

When "Polio" broke out early in May we had knapsack sprayers and dusting equipment. The State Health Department assigned a power sprayer to assist us in the emergency. We put sixty special men on spraying and house-to-house inspection crews, besides our fifteen regular sanitarians.

The Tifa fogging machine was called to our attention and after consulting the local representative, Martin-Smith Company, it suggested such improvements over the type of equipment we were using and others that were offered to us that we accepted the offer of Todd Shipyards Corporation to loan and try out their machine. We had the Tifa machine flown from New York, together with a technical expert and mechanician. We purchased the machine after giving it a thorough trial which demonstrated its superiority and economy over our other methods.

Cost of operations. We were directed by our Medical Technical Committee to spray an area of four city blocks around each case. This originally required squads of six men each, a pressure knapsack sprayer for each man, using 25% DDT Concentrate @ $2.60 a gallon mixed with five parts of water. We could not use DDT with an oil base since we were directed to spray windows, doors and screens of houses and interiors, if possible. This method of operating took six men two days using 60 gallons of DDT concentrate. These men had to be supervised and transported, thus tying up one truck, six pressure sprayers and two "spare" sprayers per squad. This cost us about $225.00 per polio case besides transportation. The whole area was not covered but just approaches of flies to each house.

2 - Dr. T. P. Handy - Laurel, Mississippi - August 6, 1946

While this was going on a crew of two men with the Tifa machine transported on a one ton truck, stake body, were covering twenty-five times the area at a cost of about $100.00 and getting complete coverage and not just special selected "targets". DDT technical grade at $.50 per pound delivered at San Antonio mixed with low grade kerosene was used in the "fogger". 3 3/4 pounds of DDT was used with each ten gallons of kerosene or 120 pounds of DDT and 320 gallons being used each eight-hour shift with the truck going at the rate of ten miles an hour. Five square miles per each eight-hour shift can be covered. Incidental equipment consists of one rotary kerosene barrel pump, one five gallon gasoline can, eight ten-gallon milk cans and a measuring can for DDT. We asked householders to open up doors and windows to let the "fog" inside the house. We added pine oil in proportions of one quart to ten gallons of liquid or eight gallons per eight hour shift at a cost of $12.00 to avoid the slightest possibility of criticism of odor and received no complaints.

We used pressure sprayers on special restricted areas such as garbage dumps, using seven ounces of DDT technical per gallon of kerosene. Spraying went on intermittently during dumping hours.

Based on our experience, we abandoned individual spraying except in special known fly-breeding spots in favor of the Tifa fogging machine for the following reasons:

1. Cost. The Tifa fogging machine very substantially reduces operating costs over other methods and brings the cost within ordinary budget resources. It can, therefore, be standard equipment and not dependent upon special emergency budgets.

2. Coverage. Immediate, expeditious and reasonably complete coverage is attainable.

3. Flexibility. Due to simplicity of the operating unit and its mobility, the Tifa machine can be diverted from systematic area fogging to special areas without loss of time or confusion.

4. Supervision and Organization. No large organization has to be built up "overnight" in case of emergency with its attendant problems of squad supervision, allocation and upkeep of many units of equipment, material-mixing and transportation.

5. Public Reception. No complaints based on bad effects of "fogging" have been filed. Numerous complaints based on intrusion into private property and damage have been received as a result of squads entering premises and spraying fly and mosquito entrances to houses.

6. Safe Mixture. Uniform, all purpose mixture was assured and the elimination of the "human factor" was procured. Changes from one type of DDT mixture to another and supervision in selecting appropriate mixture for site to be "sprayed" is eliminated.

3 - Dr. T. P. Haney - Laurel, Mississippe - August 6, 1946

7. Downtown areas can be "fogged" at night and is the only practical method we have found to cover this special area expeditiously, safely and effectively.

8. Incidental and special uses. Public auditoriums, dairy farms, stadiums and insect nuisance spots can be treated inside and out with "fog" quickly, effectively and economically. The good will resulting to the Health Department is an important consideration since other departments of municipal government, the business world and public are benefited. The equipment can be moved into areas any "power sprayer" can reach.

9. The capital investment of fifa machine delivered, plus all incidental equipment is under $1,500.00. The savings over spraying and dusting by other methods has already paid this cost and shows a saving.

10. High authorities question the efficacy of "dusting" from air and ground and spraying DDT except in limited and known fly-breeding areas. This whole controversy seems to us to be beside the point since it is predicated on the use of previously standard equipment, which we have abandoned in favor of the fifa fogger since it obviates the defects of the other methods. At any rate, our Technical-Medical Advisory Board is extremely complimentary as to the results achieved by our field force. See Time magazine, Prof. C. E. Winslow, San Antonio Evening News and San Antonio Light of August 5 and San Antonio Express of August 6th. Colonel Charles F. Craig, tropical disease expert, is quoted as saying Prof. Winslow's opinion is "one of the worst out-of-date statements I ever heard".

You will understand that this analysis is written solely from the "operations" point of view. In other words, after the directors and experts have ordered what is to be done, the mechanics, selection and procurement of equipment and materials; the problems of organizing field work and at a reasonable cost are the responsibility and "headache" of the chiefs of divisions and staff of the Health Department.

Trusting that this covers the questions in your mind when you telephoned Dr. Arendt and will be of assistance to you, I am

Very truly yours,

H. L. Crittenden

H. L. Crittenden
Administrative Assistant

HLC/lc'b

# ASSOCIATION BUSINESS

## EXECUTIVE COMMITTEE REPORT

A meeting of the Executive Committee was held at the Hotel Lord Baltimore, Baltimore, Maryland, on July 12, 1946, at 1:30 P.M.

### ATTENDANCE

President H. H. Stage
Past President Perry W. Ruth
First Vice-President R. D. Glasgow
Secretary-Treasurer T. D. Mulhern
Business Manager C. T. Williamson
Dr. George S. Comstock
Mr. R. L. Vannote

### MEMBERS ABSENT

Dr. L. A. Stearns
Mr. Duke Peters

### PAST PRESIDENT'S REPORT

Mr. Perry W. Ruth opened the meeting by an address expressing the regrets of the membership that Mr. Stage had been unable to get to the New York meeting because of the railroad strike. He went on to outline the activities of the past year, and then called upon Dr. Bishopp to induct the new president into office.

Dr. Bishopp addressed the group, expressing his satisfaction and pleasure at being called upon to induct Mr. Stage and expressed confidence that the association would prosper under his leadership. He then presented a badge of office supplied by Mr. Ruth.

Mr. Stage accepting the presidency made a plea for continued intense research to carry over into the civilian field the benefits to be derived from the new information gained and new techniques developed during the war, and thus even more effectively to combat mosquitoes and the diseases they carry. He emphasized the need to extend the membership and area served by the Association so it may operate with the greatest effectiveness.

Dr. Glasgow suggested that consideration be given the formation of a research agency within the Association to work with industry in solving the problems of joint interest and importance.

### MINUTES OF PAST MEETING

The minutes of the meeting of April 5, 1946, were read and adopted on motion by Dr. Comstock seconded by Mr. C. T. Williamson.

### SECRETARY-TREASURER'S REPORT

The Secretary-Treasurer presented a summary report which was accepted without objections as follows:

### SUMMARY REPORT OF THE TREASURER

| | |
|---|---|
| Balance on hand at audit, 5/24/46 | $844.28 |
| Receipts, 5/24/46 to date | 415.77 |
| | $1260.05 |
| Expenditures, 5/25/46 to date | 822.56 |
| Cash balance 7/12/46, in bank $429.49; in cash $8.00 | $437.49 |

### ADDITIONAL NOTES CONCERNING FINANCES

| | |
|---|---|
| Accounts receivable, members, subscribers, etc. | $325.10 |
| | $762.59 |
| Accounts payable, or dues paid in advance, etc. | 39.00 |
| | $723.59 |
| Accounts payable, not yet entered in records: Headlee flowers $20.00 | |
| Postage 20.00 | 40.00 |
| | $683.59 |

### NEW MEMBERS

Applicants for membership were read, and all were accepted on motion by Dr. Glasgow seconded by Dr. Comstock as follows:

Active: Walter G. Evans—New Jersey
John F. Healey—New Jersey
W. C. Ewing—California
Mark Louis Wodlinger—Florida

Associate: Fernando Bustamonte—Brazil
Oscar W. Deant—Massachusetts
D. E. Lane—Mississippi
Joe W. Rogers—Florida
H. W. Van Hovenberg—Texas

### WHO'S WHO IN MOSQUITO WORK

Dr. Glasgow explained that consideration has been given the publication of a list of members of the association in MOSQUITO NEWS, but that action had been deferred until consideration could be given also to a proposal to publish a more complete directory of workers engaged in mosquito control and related work. He moved that a special committee be appointed to investigate the practicability of publishing a "Who's Who in Mosquito Control and Related Work," and to explore ways and means for handling such a project. Dr. Comstock seconded the motion and it was duly passed.

### CONSTITUTION

The constitution was discussed and the need to revise it. It was the consensus of opinion that it need not be changed immediately. On one point Dr. Glasgow moved that it was the interpretation of the Executive Committee that the word "permanent" in the section relating to the Advisory Council (Article 9, Section 5) was a typographical error and should be omitted. Mr. Williamson seconded the motion and it was duly passed.

It was the consensus of opinion that the past president, Mr. Perry W. Ruth, who automatically becomes the head of the Advisory Council, should call his committee together, and initiate its work.

### ADVERTISING IN MOSQUITO NEWS

Mr. C. T. Williamson outlined the difficulties encountered by the business manager in carrying on the arduous task of soliciting advertising and reported that he had tentatively discussed with the MacFarland Agency of New York the possibility of their taking over the sale of advertising space. He pointed out that this firm had expert advertising personnel, and that it had contacts in industry, and had helped other organizations to increase their revenue from advertising. It appeared that the rate for this service amounted to about 25 per cent of the net return from advertisers. He recommended that the advertising be turned over to this firm for a trial period of perhaps two years.

Dr. Comstock moved that Mr. Williamson and the Secretary-Treasurer work out a contract with the MacFarland Company for the handling of the advertising, and to execute such a contract in the name of the Association when in their opinion it was satisfactory. Dr. Glasgow seconded the motion and it was passed unanimously.

### SURPLUS PROPERTY

The following report was read, and accepted on motion by Mr. Williamson seconded by Dr. Comstock:

"Report of the Committee on securing War Assets Administration Equipment

"To the American Mosquito Control Association

"Gentlemen:

"Your Committee consisting of Mr. J. Lyell Clarke, Major Herman Fellton and Major Russell W. Gies, appointed at the Atlantic City meeting to consider the possibility of centralizing the purchase by the mosquito fighting groups of War Surplus equipment, makes a report as follows:

"Since the Atlantic City meeting the regulations governing priorities for distributing War Surplus equipment have been radically changed. Instead of Federal Departments and Counties and Municipalities having top priority, such priority has now been given to veterans of the second World War. Because of this high priority to veterans and because of the fact that the War Assets Administration have informally advised your Committee that requests by veterans will exhaust the available supply of surplus bulldozers, tractors, cranes, etc., it seems to the Committee inadvisable to try to arrange for any centralized purchasing for the mosquito control groups in the United States. The Committee further recommends that it be discharged."

"Respectfully submitted,
"Russell W. Gies, Chairman."

There was no further business and the meeting was adjourned.

Respectfully submitted,
Thomas D. Mulhern,
*Secretary Treasurer.*

## ADVISORY COUNCIL

A meeting of the Advisory Council of the American Mosquito Association was held at the Hotel Lord Baltimore, Baltimore, Maryland, on July 12, 1946.

Attendance: Chairman Perry W. Ruth, Dr. Robert D. Glasgow, Mr. H. H. Stage, Mr. T. D. Mulhern.

After discussion, Dr. Glasgow moved that the chairman of this committee address a communication to each of the existing mosquito control organizations asking that they delegate a representative to sit with the advisory council at future meetings. Mr. Stage seconded the motion and it was passed unanimously.

There was no further business.

Respectfully submitted,
Thomas D. Mulhern,
*Secretary Advisory Council,*
*American Mosquito Control Association.*

## APPOINTMENT OF COMMITTEES

The following Committees have been appointed by the new President of the Association, Mr. H. H. Stage:

### LIST OF COMMITTEES

Committee on Legislation
Committee on Arrangements for Meetings, Inspection Trips, etc.
Committee on Nominations
Committee on Finance
Committee on Constitution
Committee on Audit
Committee on Membership
Committee on Research Fellowships
Committee on Permanent Fund

Membership of these Committees is given below.

COMMITTEE ON FINANCE

Mr. C. T. Williamson, Engineer, Chairman
Director, Suffolk Co. Mosquito Control Commission
Yaphank, L. I., New York

Mr. L. W. Smith, Engineer
Supt., Middlesex Co. Mosquito Extermination Commission
Metuchen, New Jersey

Dr. G. S. Comstock, M.D., Commissioner
Nassau Co. Mosquito Extermination Commission
Rockville Centre, L. I., New York

COMMITTEE ON CONSTITUTION

Dr. E. N. Cory, State Entomologist and Head of Dept., Chairman
Dept. of Entomology, University of Maryland
College Park, Maryland

Dr. D. MacCreary, Entomologist
University of Delaware
Newark, Delaware

Mr. V. S. Minnich, Superintendent
E. Volusia Co. Anti-Mosquito Dist.
1720 Crescent Ridge Road
Daytona Beach, Florida

COMMITTEE ON MEMBERSHIP

Mr. H. F. Gray, Engineer, Chairman
Alamedo Co. Mosquito Abatement District
1a Court House
Oakland 7, California

Dr. A. D. Hess, Malariologist
Tennessee Valley Authority
Wilson Dam, Alabama

Mr. C. C. Doenier, Entomologist
U. S. Bureau of Entomology and Plant Quarantine
Box 3391, Orlando, Florida

Dr. Hernando Rey, M.D., Malariologist and Head of Division
Malaria Division
Carrera 13, # 32–39
Bogotá, Colombia, So. America

Dr. Luis Vargas, Entomologist
C. Escuela Medico
Militer # 20
Mexico D.F., Mexico

Mr. John N. Huber, Entomologist
Mosquito Control Project
3425 N. E., 40th Ave., Portland, Oregon

Miss Helen L. Trembley, Entomologist
USPHS, Div. of Physiology
Bethesda, Md.

Mr. Anthony Roth, Entomologist
Bureau of Entomology and Plant Quarantine
Box 332, Corvallis, Oregon

COMMITTEE ON LEGISLATION

Mr. R. L. Vannote, Engineer and Entomological Consultant, Chairman
Formerly Secretary, Morris Co. (N. J.) Mosquito Extermination Commission (Retired)
Box 25, Morristown, New Jersey

Dr. L. A. Stearns, Professor and Head
Entomology Dept., University of Delaware
Newark, Delaware

Mr. F. H. Stutz, Director
Dade Co. Anti-Mosquito District
Room 1203, County Court house
Miami 32, Florida

Mr. Harold F. Gray, Engineer
Alameda Co. Mosquito Abatement District
1-A Court House, Oakland, California

COMMITTEE ON ARRANGEMENTS
(Meetings, Inspection Trips, etc.)

Mr. R. E. Dorer, Asst. State Director, Chairman
Malaria Control Div., State Dept. of Health
300 Essex Bldg., Norfolk, Virginia

Mr. W. E. Bickley, Entomologist
USPHS, Malaria Control in War Areas
300 Essex Bldg., Norfolk, Virginia

Mr. H. F. Nicholson, Entomologist
USPHS, Malaria Control in War Areas
300 Essex Bldg., Norfolk, Virginia

COMMITTEE ON NOMINATIONS

Dr. E. F. Knipling, Entomologist, Chairman
U. S. Bureau of Entomology and Plant Quarantine
Box 3391, Orlando, Florida

Mr. Herbert Knutson, Entomologist
Rhode Island State College
Kingston, Rhode Island

Dr. Carl J. Drake, Entomologist
Iowa State College of Agriculture
Ames, Iowa

COMMITTEE ON AUDIT

Dr. G. S. Comstock, M.D., Commissioner, Chairman
Nassau Co. Mosquito Extermination Commission
Rockville Centre, L. I., New York

Mr. W. J. Haude, Entomologist
John Powell & Co.
114 E. 32nd St., New York City

Dr. E. J. Hansen, Asst. Entomologist
N. J. Agricultural Experiment Station
New Brunswick, New Jersey

COMMITTEE ON RESEARCH FELLOWSHIPS

Dr. R. D. Glasgow, State Entomologist, Chairman
N. Y. State Science Service, Univ. of the State of New York
State Education Bldg., Albany, N. Y.

Dr. F. C. Bishopp, Asst. Chief, in Charge of Research

U. S. Bureau of Entimology and Plant Quarantine
Washington 25, D. C.

Lt. Col. G. W. Bradley, Entomologist
USPHS, Malaria Control in War Areas
605 Volunteer Bldg., Atlanta, Georgia

Dr. W. B. Herms, Entomologist
Professor of Entomology
University of California, Berkeley, California

Mr. H. L. Fellton, Engineer and Entomologist
Orkin Exterminating Co., Inc.
547 W. Peachtree St.
Atlanta, Ga.

COMMITTEE ON PERMANENT FUND

Mr. Frank K. Steinrock, Engineer, Chairman
Vice-President, Todd Shipyards Combustion Equipment Div.
601 West 26th St., New York City

Mr. H. W. Van Hovenberg, Sanitary Engineer
St. Louis Southwestern Railway Co.
Box 288, Mt. Pleasant, Texas

Mr. Stanley J. Carpenter, Entomologist
National Biscuit Co.
449 W. 14th St., New York City

## "BUREAU OF AGRICULTURE DEPARTMENT COMMENDED FOR DEVELOPMENT OF INSECT REPELLANTS"

*(Bureau of Entomology and Plant Quarantine)*

(Copied from *Tropical Medicine News,* Vol. 3, No. 3 (June, 1946), pp. 16–17, credited to "Navy Press Release, April 11, 1946.")

"Secretary of the Navy James Forrestal and Vice-Admiral Ross T. McIntire, Medical Corps, U.S.N., Surgeon General of the Navy, have commended the Bureau of Entomology and Plant Quarantine of the Department of Agriculture for research conducted in the development of insect and mite repellents.

"In a letter to the Secretary of Agriculture, Secretary Forrestal stated that the Bureau of Entomology and Plant Quarantine 'rendered a fundamental and outstanding contribution to Naval forces which has changed the entire methodology in the control of insect-borne diseases.'

"Vice-Admiral McIntire, in letters of commendation to Dr. P. N. Annand, Chief of the Bureau, and 32 of his associates, said that the immediate recognition of the great military potentialities of insecticides, such as DDT, aerosols, insect repellents and protective fabrics, resulted in their conversion to maximal efficiency for military use.

"The close cooperation and assistance rendered the Navy by the Bureau of Entomology and Plant Quarantine were in a large measure responsible for the successful development of the repellents which made it possible to carry on our military campaigns in tropical areas with a freedom from disease formerly thought impossible, the Surgeon General pointed out.

"Much of the work on the control of insect-borne diseases and experiments with the repellents was performed at the Bureau's Orlando, Florida, Laboratory, of which E. F. Knipling is in charge.

"In addition to Dr. Annand and Mr. Knipling, letters of commendation from Vice-Admiral McIntire have been sent to Dr. F. C. Bishopp, Assistant Chief of the Bureau, Dr. W. E. Dove, Gaines W. Eddy, H. H. Stage, Howard A. Jones, Arthur W. Lindquist, Raymond C. Bushland, Bernard V. Travis, James B. Gahan, Fred M. Snyder, A. H. Madden, L. C. McAlister, F. A. Morton, H. O. Schroeder, Chester N. Husman, Dr. C. C. Deonier, C. P. Clausen, J. H. Fales, E. R. McGovran, Randall Latta, Dr. R. C. Roark, Dr. S. J. Cristol, E. L. Gooden, Dr. L. D. Goodhue, E. E. Fleck, S. A. Hall, Dr. H. L. Haller, M. S. Schechter, S. B. Soloway, Dr. F. B. LaForge and W. Barthel."

# NEWS AND NOTES

DR. THOMAS J. HEADLEE died at his home in New Brunswick, New Jersey, on June 14, 1946. A pioneer and leader in mosquito control activities, he has left many friends, co-workers, and students in this Association who will miss his leadership and friendship. An account of his distinguished career will be published in a later number of the NEWS.

E. F. KNIPLING APPOINTED HEAD OF B.E.P.Q. DIVISION OF INSECTS AFFECTING MEN AND ANIMALS. The Bureau of Entomology and Plant Quarantine's Division of Insects Affecting Man and Animals has a new divisional head. Edward F. Knipling was appointed September 15, 1946, to take over the duties of Emory C. Cushing, who resigned to return to his Texas ranch near San Antonio.

EDWARD F. KNIPLING, Newly Appointed Head of the Division of Insects Affecting Man and Animals, U. S. Bureau of Entomology and Plant Quarantine, U.S.D.A. Photograph by Knell.

Mr. Knipling, connected with the Bureau since 1931, with a Bachelor of Science degree from Texas A. & M. and a Master of Science degree from Iowa State College, has conducted most of his investigative work in the field of medical and veterinary entomology. As senior entomologist in charge of the Bureau's Orlando Laboratory during the war years, he participated in the development and adaptation of practically all of the insecticides, repellents, and methods employed for their application, used by the allied armed forces in the United States and abroad, during World War II. He was awarded the United States Typhus Commission medal in May, 1946, for his contributions to these developments.

Mr. Cushing was first appointed as head of this division in 1941. He has been connected with the Bureau since 1928. His work chiefly concerned investigations of insects affecting man and animals; it was he who first pointed out that the fly causing most of the screwworm damage in this country was not that which occurred commonly in carcasses of animals. As a Colonel in the Sanitary Corps of the Army of the United States, Mr. Cushing earned a citation for typhus control in combat areas. He was awarded the Typhus Commission Medal in May, 1945.

G. J. HAEUSSLER

"THE 'SKEETER,' A Paper Devoted to Mosquito Control in Virginia," has recently appeared in the Editor's mail basket. Numbers ("Edition") 1 (July, 1946) and 2 (August, 1946) of Volume 2 have come so far. The "Skeeter" is a chatty, three page, mimeographed leaflet reporting largely items of interest concerning mosquito control activities in the state of Virginia; and represents a movement that might be duplicated with advantage in many other states or sections where mosquito control and related work is an object. Number 1 begins with the announcement:

"The 'Skeeter' is to be published monthly in the interest of mosquito control in Virginia. One of its purposes is to familiarize the various communities doing mosquito control with what is being done in other communities. Through its pages, it is hoped to educate those interested in mosquitoes. Also, perhaps, this organ may interest other communities who have a mosquito problem in setting up suitable control measures. Current happenings in Mosquito Control both in Virginia and other states will be reported."

R. D. G.

DR. W. H. W. KOMP. "To quote Doctor Komp (W. H. W.), Sanitary Engineer Director, U.S.P.H.S., Malaria Investigations, Ancon, Canal Zone: 'Just got back from three months in Bolivia and Brazil. I hope to get up to the States again in November.'"

HELEN LOUISE TREMBLEY

DR. FERNANDO BUSTAMANTE. Extracts from an air mail letter.

"I have just had an air mail letter from Dr. Fernando Bustamante, Chief of the Control Division, Service Nacional de Malaria, Rua Pereira,

Barreto 14, Apr. 201, Tijuca, Rio de Janeiro, Brazil.

"Since the first of August, Dr. Bustamante has been attending the III Governmental Course in Malariology, headed by Dr. Arnoldo Gabaldon (also one of our members) at Maracay, Venezuela. He will continue to be there until December, at which time he expects to return to Brazil to resume his duties directing Control operations in Rio.

"While in the United States Dr. Bustamante visited several Malaria Control Projects, and recalls interesting hours spent at the following:

"1. Harvard School of Public Health, Dept. of Comp. Pathology and Tropical Medicine, Boston, Mass.

"2. National Institute of Health, Bethesda, Md.

"3. Station for Malaria Research, Tallahassee, Fla.

"4. Malaria Control in War Areas, U. S. Pub. Hlth. Serv., Atlanta, Savannah, Albany, and Emory University Field Station, Georgia.

"5. Tennessee Valley Authority, Wilson Dam, Alabama.

"6. Bureau of Malaria Control, Florida St. Bd. of Hlth., Jacksonville.

"7. Bureau of Entomology and Plant Quarantine, U. S. Dept. of Agriculture, Orlando, Florida." HELEN LOUISE TREMBLEY

CAPTAIN JOHN M. ELLIS was released from active duty with the U. S. Public Health Service on June 2, 1946, to accept a position as associate professor of biology at Alabama Polytechnic Institute at Auburn, Alabama. While in the Service he was stationed in Atlanta, Georgia, and Longview, Texas, in connection with malaria control and investigations. He was in the Service for a period of 34 months. D. C. THURMAN

MAJOR FRANK W. FISK received his release from active duty with the commissioned corps of the U. S. Public Health Service on April 3, 1946, and accepted a position as entomologist with Malaria Control in War Areas in Louisville, Kentucky. Major Fisk served a period of 4½ years, part of which was spent in the C.B.I. theater of operations. D. C. T.

LIEUTENANT EDWIN L. SEABROOK was released from active duty with the U. S. Public Health Service March 11, 1946, to return to his position as entomologist in charge of mosquito control for the Palm Beach County Anti-Mosquito District, West Palm Beach, Florida. Lt. Seabrook served 33 months on the Malaria Control in War Areas Program. D. C. T.

CAPTAIN HERBERT H. KNUTSON was released from active duty with the U. S. Public Health Service March 6, 1946, to return to his former position at the Rhode Island State College, Kingston, R. I., in the Department of Zoology and Entomology. Captain Knutson served 35 months with Malaria Control in War Areas. D. C. T.

CAPTAIN CHARLES E. GERHARDT was released from active duty with the U. S. Public Health Service during May, 1946, to accept a position with Orkin Exterminating Company, Roanoke, Virginia. Captain Gerhardt served 29 months on the Malaria Control in War Areas program. D. C. T.

RETURNED FLORIDA MOSQUITO WORKERS. "I herewith enclose (7/10/'46) a list of names of many of the mosquito workers in this State who have returned from the Service, with some information regarding each." H. D. PETERS

1. DAVID B. LEE, Chief Sanitary Engineer, Florida State Board of Health, Jacksonville, Florida. (Army: Duty on malaria control in New Guinea, South and Central America and West Indies.)

2. CLAUD R. STRICKLAND, Sanitarian, Pinellas County Health Dept., Clearwater, Florida. (Army: Duty on malaria control in Africa.)

3. DR. JOHN W. WILSON, Entomologist, University of Florida Agricultural Experiment Sta., Belle Glade, Florida. (Army: Duty on malaria control in India Theater, Assam and vicinity.)

4. MELTON WILLIAMS, Director, Sarasota County Mosquito Control District, Sarasota, Florida. (Navy: Duty on mosquito and malaria control in West Indies.)

5. FRANK HAYS, Sanitarian, Pinellas County Health Dept., St. Petersburg, Florida. (Army: Duty on malaria control in New Guinea and South Pacific.)

6. HENRY B. CROWELL, Director, Division of Sanitation, Hillsborough County Health Dept., Tampa, Florida. (Army: Duty on malaria control in Guadalcanal and South Pacific.)

7. DR. WILLARD V. KING, Bureau of Entomology and Plant Quarantine, U. S. D. A., Orlando, Florida. (Army: Duty on malaria control in States and South Pacific Theater.)

8. DR. B. V. TRAVIS, Bureau of Entomology and Plant Quarantine, U. S. D. A., Orlando, Florida. (Navy: Malaria control in Okinawa and other points in Pacific Theater.)

9. L. E. MCDONALD, CAPT. (MC), U. S. N. Staff Medical Officer, U. S. Naval Air Station, Jacksonville, Florida. (Navy: Mosquito and malaria control in States and other points.)

PROCEEDINGS AND PAPERS OF THE FOURTEENTH ANNUAL CONFERENCE OF THE CALIFORNIA MOSQUITO CONTROL ASSOCIATION, FEBRUARY 25 AND 26, 1946. Edited by H. F. Gray. A copy of these Proceedings was received too late for extended notice in the current issue of the NEWS. It will be reviewed in the "Reviews and Abstracts" section in a later number. D. L. C.

CLIPPINGS ON MALARIA. TIJERETAZOS SOBRE MALARIA. Revista Editada por la Division de Malariologia, Direccion de Salubridad Publica, Ministerio de Sanidad y Assistencia Social, Maracay, Aragua, Venezuela. This interesting and valuable periodical, which has heretofore been issued in mimeograph form, is now issued in

attractive print on book stock, beginning with Number 1 of Volume 10 (March, 1946). The editor, the division of malariology, and the Department of Public Health of the Ministry of Health and Social Welfare are to be congratulated upon the fine appearance of the *Tijeretazos* in its new form.

The editorial on the first page traces the history of the publication from its beginning in July, 1938, to the present. Begun as an abstract journal, or review, the *Tijeretazos* soon served also as the medium for the publication of original papers of timely interest and importance. In order that these articles might achieve the permanence and wide circulation which they deserve, the new form of the periodical has been adopted, a step which should help insure its rightful place in its special field.

No. 1 of Vol. X contains the following three special articles: (English translations of original Spanish titles) *The Problem of Malaria in Haiti,* by Athenas Bellerive and Charles Dambreville; *Suggestions for Workers on Spleen Indices,* by Antonio Gomez Marcano; *Zoogeography of the Anophelines in Venezuela: 1. The Two Chief Vectors,* by Arnoldo Gabaldon and Pablo Cova-Garcia. (The two "chief vectors" are *A. albimanus Wiedemann* and *A. darlingi* Root.)

In addition to the special articles there is a translation into Spanish of the English paper *The Seasonal Periodicity of Malaria and the Mechanism of the Epidemic Wave* by J. A. Churchill.

The "Abstracts" section contains short abstracts of 20 papers from various journals from all parts of the world. These are classified on the basis of subject matter.

The "Noticias" section contains news notes of interest to malaria control workers, originating in the several Latin American countries.

D. L. C.

A NEW SOUTH AMERICAN JOURNAL OF APPLIED ENTOMOLOGY. Revista Sudamericana de Entomologia Aplicada. Editada en colaboracion con los mas destacados entomólogos sudamericanos, especializados en entomología médica, agrícola, veterinaría, etc., por G. Dennler de la Tour, Dr. en medicina y ciencias naturales, Seaver 1656, Buenos Aires, Argentina.

An item of unusual interest is the announcement of the publication of this new "South American Journal of Applied Entomology," scheduled to appear by the end of the year 1946, in Buenos Aires, Argentina. According to the announcement the Journal will consist of three independent sections, as follows: Section G: General and Miscellaneous; Section A: Agriculture and Phytopathology; Section M: Medical and Veterinary.

Each section will have three series which will be published in independent fascicles:

Series O: Original contributions.

Series B: Annotated bibliography.

Series C: Communications and Miscellaneous.

Each *section* will form its own independent volumes. A volume will be complete when it reaches about 300 pages.

Information on subscriptions may be obtained by addressing Señor Administrador de la Revista Sudamericana de Entomologia Aplicada, Casilla de Correo, 2498, Buenos Aires. The editor, Dr. G. Dennler de la Tour, may also be reached at the same address. D. L. C.

# EDITORIAL SECTION

## THE DRIVE FOR NEW MEMBERS

We are now starting a drive to bring new members into the American Mosquito Control Association, and earnestly solicit the cooperation of every present member.

The Association and MOSQUITO NEWS have much to offer our members in mutual service and cooperation; and opportunities for this cooperative service will grow progressively as our membership increases.

At the close of its meeting on May 24–25, 1946, membership in the Association was reaching beyond the continental United States to include administrative, professional and other personnel concerned with or interested in mosquito control and related work in Australia, Belgium, Canada, Canal Zone, Ceylon, China, Columbia, Equador, England, France, Haiti, Hawaii, Mexico, Panama, Puerto Rico, and Venezuela.

Millions of Americans who have personally observed the importance and effectiveness of mosquito control and related work in war areas and who have now returned to their homes, are going to demand that our local governments awake more generally than hitherto, to the need of such work in every community in the United States; a need that is likewise coming to be recognized throughout North America, the entire Western Hemisphere, and the whole world.

**The American Mosquito Control Association is the logical agency to spear-point at least throughout the Western Hemisphere the coming great extension of practical pest control work in the entire field of Medical Entomology; of which mosquito and malaria control constitute so large a part.**

We need as members of the Association, and as readers of, and contributors to MOSQUITO NEWS, everyone who may be interested in any way in the promotion, organization, operation, and improvement of this essential public service, and in extending the special fields of knowledge upon which it is based. We need teachers, and members of forward looking women's clubs and other civic organizations, as well as public health officials, medical personnel, research pathologists, entomologists, and mosquito control engineers.

**We need all of these; but we need especially members who are willing and qualified to assume the responsibilities of leadership in the Association, and in the work for which it stands.**

We are depending upon you present members individually to suggest the names of as many persons in your part of the country as you can, who should be invited to become members; or the names of anyone anywhere who might be interested. We are depending upon you personally to persuade as many prospective members as possible to fill out the application form over your own signed recommendation of the applicant for membership.

Please do not neglect any name through fear of duplication. Duplicate names will be sorted out by the Committee on Membership; and multiple suggestion of a name might constitute a special form of recognition.

For your convenience, a blank form has been bound into the center of this number.

Please fill out and mail, either to a member of the Committee on Membership, or to T. D. Mulhern, Secretary-Treasurer, American Mosquito Control Association, New Brunswick, New Jersey.

COMMITTEE ON MEMBERSHIP

See page 156 for members of the Committee.

# REVIEWS AND ABSTRACTS

BROMELIAD MALARIA IN TRINIDAD, BRITISH WEST INDIES. By W. G. Downs and C. S. Pittendrigh, 1946. Amer. Jour. Trop. Med., 26(1):47–65, 20 refs., illus. Although much controversy has taken place concerning the possibility of bromeliad-breeding anophelines of the subgenus Kertzia being involved in malaria transmission, it has been confirmed by Rozeboom and Laird as well as by Downs, Gill, and Shannon that *Anopheles (Kertzia) bellator* D. and K. is a vector of malaria in Trinidad. Many of the forests there in which this species is found, are man made. They consist of cacao plants interspersed with immortelle trees, the latter supporting many species of bromeliads which, through their ability to hold water, are good breeding places of *A. bellator*. Despite the fact that *A. bellator* is a forest species, it is closely associated with man in the cacao areas. It lives in the drier microclimates of the forest but it often leaves the forest for drier conditions offered by the cacao estates and open areas in the villages. The cacao industry has brought relatively large human settlements into immediate contact with the forest of cacao and imortelle trees. *A. belator* breeding is restricted to certain species of bromeliads and does not occur in the drier parts of the island.

Present methods for control of this anopheline are based upon elimination of the bromeliads by hand. This process is hazardous and time consuming. The immortelle trees have thorns; the branches break easily; and the cost, varying from $22 to $128 per acre, is prohibitive in many areas. Of the chemicals tested to kill the bromeliads, 2 per cent copper sulfate solution has given the best results. This material does not injure the cacao or immortelles. Since the spray must reach a height of 70 to 100 feet, the equipment found best suited for this purpose is that developed by the United States Department of Agriculture for use in control of the gypsy moth.

The most lasting and economical control measures advocated, however, would be a change in agricultural practices such as the use of windbreaks on the cacao plantation in place of the immortelles. Trees, such as the mango, used for windbreaks, do not support the great bromeliad flora of the immortelle and would at the same time have some commercial value. Through such a conversion, the populations of *A. bellator* could be reduced or eliminated.—HELEN SOLLERS, Bur. Ent. and Plant Quar., Agr. Res. Adm., USDA, Washington, D. C.

THE MOSQUITOES OF THE SOUTHERN UNITED STATES EAST OF OKLAHOMA AND TEXAS. Stanley J. Carpenter, Woodrow W. Middlekauff, and Roy W. Chamberlain. The American Midland Naturalist, Monograph No. 3, 292 pp., 155 figs. The University Press, Notre Dame, Ind., May, 1946. $4.00. Another revision of the mosquitoes of the southern United States might appear to be unnecessary in view of the recent works of King, Bradley and McNeel, and of Matheson, but the additional information contained in this work, and the quantity and quality of the illustrations fully justifies its publication. It is primarily a taxonomic handbook, designed to aid entomologists and public health workers in the collecting, preparation, and identification of mosquitoes. There is a brief general discussion of the life history and medical importance of mosquitoes, followed by an excellent section of 17 pages on the techniques of collecting, transporting, storing, preparation for study, and equipment for identification of mosquito adults and larvae. Methods for the collection of mosquito eggs are also given, but no suggestion as to how to preserve them. A well illustrated section of 25 pages explains the characters used in the identification of adults, larvae, pupae, and eggs, followed by keys to the subfamilies and tribes of the Culicinae.

The rest of the book, with the exception of a bibliography of 188 titles, and a very complete index, is devoted to the keying and description of the 11 genera and 71 species or subspecies of the region under consideration, with notes on the distribution, biology, and medical importance if any. Page references are given in the keys so that one can turn immediately to the descriptive treatment of the species and the species are arranged alphabeticaly under each subgenus. Because most of the species are well catalogued in recent works few citations other than the original ones are given under the species. The adult female, adult male, and larva are described for each species. Of particular value are the excellent drawings of adult and larval structures by Mrs. Elizabeth Kaston. These are distributed through the text so that usually one does not have to turn from the description to consult the illustrations, and they are sufficiently large to show all of the structures clearly. The paragraph on distribution gives the over-all range followed by the distribution in the Southern States by state, with bibliographic references to the records. The writers have utilized recent records as much as possible as being more readily available and reliable. The paragraph on biology for each species includes brief notes on feeding habits, breeding places, and seasonal distribution, the latter drawn largely from the unpublished records of the Fourth Service Command Medical Laboratory.

The authors are to be congratulated on preparing this fine manual, and the publishers in getting it out in such excellent style. It is a book that will be of immense value to any who wish to know how to collect, preserve and identify mosquitoes in the South. While there will still be additional species found in the South, this manual will be the most comprehensive and valuable work on the subject for a long time to come.

ALAN STONE

Use of Insect Repellents and Miticides. By B. V. Travis and F. A. Morton. Circular E 698, August, 1946, Bureau of Entomology and Plant Quarantine, U. S. Department of Agriculture.

This circular gives information on the availability, use, and effectiveness of the few new repellents and killing agents which, from among many thousands of chemicals tested, appear to give some measure of protection from the bites of mosquitoes, punkies, blackflies and other biting flies, chiggers, and mites. Five "safe" formulae are given. Two of these are mixtures of dimethyl phthalate, indalone and Rutgers 612 (2-ethyl-1, 3-hexanediol); the third is a mixture of dimethyl phthalate, indalone and dimethyl carbate; the fourth is dimethyl phthalate and Rutgers 612; and the fifth is dimethyl phthalate and dimethyl carbate. The directions for using these materials and various characteristics and results that may be expected are given in detail. A list of firms which can supply the chemicals completes the circular. D. L. C.

Estudio Ecologico de los "Criaderos" de *Anopheles pseudopunctipennis,* Theob. By G. Dennler de la Tour. Revista Argentina de Zoogeografia, Vol. IV, No. 3, 1944, pp. 145–154. 5 plates. (Ecological Study of the Breeding Places of *A. pseudopunctipennis.*) Paraphrase of English summary:

Ecological studies of the breeding places of *Anopheles pseudopunctipennis* have not only a scientific interest but also a practical side. The species is the host of the plasmodium which is the agent of endemic malaria in northwest Argentina. It does not breed in pools and stagnant waters as many other anopheline species do. On the contrary, *A. pseudopunctipennis* breeds on the borders of running waters (rivers, etc.). The water must be clear and continually renewed, needing also the presence of filiform green algae (Spirogira and the like), typically present in mountain rivers and rivulets. The zoogeogram shows that *A. pseudopunctipennis* is limited to the zone comprising the eastern hillsides of the "Cordilleras" up to a height of 1.350 meters above sea level and down to the plains where water currents cease in winter. D. L. C.

Field Bulletin of Malaria Control in War Areas, U. S. Public Health Service, Federal Security Agency. January, February, March, 1946.

Included in this issue of the Bulletin are two papers of interest to mosquito control workers.

1. Malaria Education in Arkansas. By Asst. San. (R) Robert H. McCauley, Jr. This report is a very informative description of the malaria education program carried out in Arkansas by the MCWA beginning in 1944. Photographs of methods and typical situations, although they represent standard procedures already known to every mosquito control worker, add greatly to the interest for a lay reader.

2. Some Unusual Breeding Places of *Anopheles quadrimaculatus,* by San. (R) T. E. McNeel. The list of so called "unusual breeding places" mentioned in the title has been obtained from both the literature and the experience of MCWA entomologists. It includes artificial containers, saline water, bilge water in a houseboat, fire barrels, armadillo holes, tin cans in a dump almost completely filled in with and covered by dirt, airplane wheel ruts on muddy landing fields, a flooded concrete room, sewers and septic tanks, and flowers of the Nassau Lily.

In conclusion the author remarks that "quads" will apparently breed almost anywhere unless the water is extremely foul; but, as he cautions in the introduction, the observation of limited breeding in a few unusual places should not upset the established conception of quad ecology. Oviposition in unusual places usually occurs only when the adult population is unusually high or when available water is very scarce. D. L. C.

Malaria Control in a Nonendemic Area. By Herman L. Fellton, Ralph C. Barnes and Arlie Wilson. The Journal of The National Malaria Society, Vol. IV, No. 3, Sept., 1945.

The consensus of opinion of the majority of recognized authorities on malaria is that there is no danger of the re-establishment of the disease on an endemic basis in non-endemic areas in the United States as a result of the return of military service personnel. While the danger of severe epidemics is also not great, it would be wise to undertake certain precautionary measures, in areas where malaria mosquitoes occur, but which have been free from infection for many years.

To carry out these precautions in the Northeastern United States a Malaria Control in War Areas Sub Office was established in the U. S. Public Health Service District No. 1 with Headquarters in New York City. Anti-malarial measures in the area included the establishment of mobile malaria control units; extensive anopheline surveys at possible danger points; anopheline control measures where concentrations of human carriers and the mosquito vector are found; and educational measures. Each mobile unit consisted of a station wagon and a 1½ ton truck for equipment and supplies necessary for entomological surveys, larviciding, minor drainage, clearing, cleaning and spray killing of adults. The anopheline surveys in 1943 and 1944 are also described, together with the anopheline control procedures and educational measures that were employed. D. L. C.

Malaria Control in the Northeastern States. By Herman L. Fellton, Ralph C. Barnes, C. Arlie Wilson and Miriam Boyers. Proceedings of the Thirty-Second Annual Meeting of the New Jersey Mosquito Extermination Association, March 28, 29 and 30, 1946.

During 1943 and 1944 anopheline surveys were conducted around certain military installations in all the states of U. S. Public Health

Service District No. 1, except Vermont. *A. quadrimaculatus* was found in 32 of the 57 zones surveyed, and in a majority of these stations was the predominant species. It was found that the breeding season began somewhat earlier than previously supposed in these areas, as early as the first part of May as far north as Framingham, Mass. Significant hibernation records were obtained, and it was planned to continue the observations in greater detail.

*Anopheles bradleyi* King also occurred in some of the collections made in 1944, in New Jersey and Delaware, and at Orangeburg and New York City.

Control measures were restricted largely to larviciding the *A. quardimaculatus* breeding places, with clearing and cleaning where feasible, and a limited amount of minor drainage. At Fort DuPont, Delaware, airplane dusting with paris green was employed to treat certain extensive muskrat marshes.

Educational measures were also undertaken, including the direct instruction of state health department employees, district sanitary engineers and others.

Included in the paper is a valuable list of *A. quadrimaculatus* locality records, as established by the collections of the Malaria Control in War Areas group, the literature and from personal communications with other workers. D. L. C.

AN OLD CHEMICAL COMPOUND REVEALED AS AN EXCEEDINGLY POTENT INSECTICIDE. By J. G. Sanders. The Scientific Monthly, Vol. LXII, No. 5, May, 1946; pp. 465–466.

The chemical compound currently known as "benzene hexachloride," or "666," but more accurately designated as "1,2,3,4,5,6-hexachlorocyclohexane," has achieved far less publicity than DDT, but appears actually to be several times more toxic to many insects than DDT. As pointed out by Mr. Sanders, it has been known for over 100 years, having been discovered by Faraday in 1825; but the knowledge of its potency as an insecticide has been comparatively recent. Of especial interest to persons concerned with mosquito control is the effectiveness of "benzene hexachloride" against mosquitoes and other insects annoying or dangerous to man. The following excerpts from the paper cited are given here in order to bring this interesting compound to the attention of mosquito control workers who may not be aware of its possibilities. "In the control of mosquitoes and flies under varied field conditions as well as in human habitations, the *gamma* isomer has shown amazing toxicity, with a killing power 8 or 9 times that of DDT and about 18 times that of pyrethrins. In field tests, including some in Western Africa and Ceylon, one-half pound per acre of the crude material in the form of dust produced 100 per cent kill of mosquito larvae in 24 hours—an indication of the usefulness of benzene hexachloride in controlling these disease-bearing pests over large areas with applications from airplanes. . . . Benzene hexachloride apparently does not have the long residual effect in controlling houseflies and mosquitoes that is characteristic of DDT. . . . The excellent and informative lecture by R. E. Slade, published and illustrated in *Chemistry and Industry,* October 13, 1945, should be carefully studied by everyone who proposes to carry on studies and experimental work with this promising insecticide. The article is replete with useful information on the chemical and physical properties of the compound. Reported results of early tests on a fairly wide range of injurious insects point to a broad field of usefulness in the control of insect pests of agricultural and horticultural products, domestic animals, and mankind."

D. L. C.

# GENERAL BIBLIOGRAPHY

## REFERENCES TO LITERATURE OF INTEREST TO MOSQUITO CONTROL WORKERS

H. H. STAGE

Bureau of Entomology and Plant Quarantine
Agricultural Research Administration
United States Department of Agriculture

ANONYMOUS. 1946. Encephalitis and entomology. Brit. Med. Jour. No. 4450, 613–614, 1 ref.

———— 1946. "Jeep" aerosol generator for DDT applications. U. S. Army Med. Dept. Bul. 5(5):514–515, 2 figs.

———— 1946. Malaria control (in Turkey). Amer. Med. Assoc. Jour. 130(16):1188.

———— 1946. Mosquito control. Soap and Sanit. Chem. 22(2):149.

———— 1946. New DDT applicators for screens. U. S. Army Med. Dept. Bul: 5(5):502–503, 5 figs.

ANTUNES, W., and CASTRO, A. 1945. Zona endemica da febre amarela no Brasil. Pan Amer. Union Bol. de la Ofic. Sanit. 24(11):972–979, 5 figs.

BACIGALUPO, J. 1945. Importancia de algunos de nuestros mosquitos en la transmision de la filaria del perro en la Argentina. Puerto Rico Jour. Pub. Health and Trop. Med. 21(1): 3–13, 11 figs., 2 refs.

BARNES, R. C. 1946. The occurrence of *Anopheles quadrimaculatus*, *Anopheles occidentalis* and *Anopheles walkeri* in Vermont. MOSQUITO NEWS 6(1):32–33, 3 refs.

BICK, G. H. 1946. Collections of mosquitoes on Parris Island during 1945. Jour. Econ. Ent. 39(1):89–91, 3 tables, 2 refs.

BIRRELL, N. V. 1946. A case of indigenous malaria in northern Ireland. Brit. Med. Jour. No. 4451:649–650, 3 refs.

BISHOP, A., and GILCHRIST, B. M. 1946. Experiments upon the feeding of *Aedes aegypti* through animal membranes with a view to applying this method to the chemo-therapy of malaria. Parasitology 37(1–2):85–100, 14 tables, 2 figs., 25 refs.

BOHART, R. M. 1946. New species of mosquitoes from the Marianas and Okinawa (Diptera, Culicidae). Wash. Biol. Soc. Proc. 59:39–45, 23 figs.

BOYD, M. F. 1946. International appraisal of research in tropical medicine. Amer. Jour. Trop. Med. 26(1):1–4.

BRUMPT, E. 1944–45. Anophelisme sans paludisme et regression spontance du paludisme. Ann. de Parasitol., Humaine et Compar. 20(1–2): 67–91, 80 refs.

CALLOT, J., and VANTY, D. 1944–45. Contribution a l'etude des moustiques Francais culicides de Richelieu (Indre-et-hoire). Ann. de Parasitol. Humaine et Compar. 20(1–2):43–66, 2 tables, 2 plates, 29 refs.

CAMERON, T. W. M. 1945. Is malaria a post-war threat? Canad. Business 18(6):32–33, 104, 106.

CAMPBELL, G. A. 1945. Anti-malaria drainage in Trinidad. Engin. Jour. 28(11):695–702, 9 figs.

CANAMARES, F. T. 1945. Contribucion al conocimiento del *Anopheles claviger* Mg. de España (Dip. Cul.). Eos 20(3–4):233–245, 6 figs., 3 refs.

CARPENTER, S. J., and CHAMBERLAIN, R. W. 1946. Mosquito collections at army installations in the Fourth Service Command, 1943. Jour. Econ. Ent. 39(1):82–88, 7 tables.

CERQUEIRA, N. L., and PARAEUSE, W. L. 1945. Una nova especie de *Aedes*, transmissora de *Plasmodium gallinaceum* (Diptera, Culicidae). Inst. Oswaldo Cruz Mem. 42(1):11–15, 4 figs., 2 refs.

CHANDLER, A. C. 1945. Factors influencing the uneven distribution of *Aedes aegypti* in Texas cities. Amer. Jour. Trop. Med. 25(2):145–149, 1 ref.

CHRISTOPHERS, S. R. 1945. Structure of the *Culex* egg and egg-raft in relation to function (Diptera). Roy. Ent. Soc. London, Trans. 95(2):25–34, 23 figs., 2 refs.

COGGESHALL, L. T. 1946. Filariasis in the serviceman: Retrospect and prospect. Amer. Med. Assoc. Jour. 131(1):8–12, 3 tables, 5 refs.

COLLADO, J. G. 1945. Los mosquitos del paludismo. Madrid Hojas Sivulgadoras. 37(29): 1–16, 7 figs.

CORRADETTI, A., and ANGELICO, R. 1945. La particolare chetotassi della ninfa di *Anopheles algeriensis*. Soc. Ital. di Biol. Sper. Bol 22(4–4): 221–222.

COTTAM. C. 1946. DDT and its effect on fish and wildlife. Jour. Econ. Ent. 39(1):44–52.

COUTINHO, J. O., and RICCIARDI, I. 1945. Contribucias para o estudo dos vetores de malaria no Brasil. *Anopheles (Nyssorhynchus) darlingi* Root, em Campos no Estado de Rio. Inst. Oswaldo Cruz Mem. 42(1):263–280, 10 tables, 17 refs.

COVELL, G. 1945. False economy in the planning and conduct of antimalaria campaigns. Malaria Inst. India, Jour. 6(2):247–249, 1 ref.

COXON, R. V., and HAYES, W. 1945. Investigation into the efficacy of sulphadiazine in the treatment of malaria. Roy. Soc. Trop. Med. and Hyg. Trans. 39(2):195–205, 2 graphs, 3 refs.

CULBERTSON, J. T., ROSE, H. M., and OLIVER-GONZALEZ, J. 1946. Chemotherapy of filariasis

due to *Wuchereria bancrofti* with neostibosan. Amer. Jour. Hyg. 43(2):145–151, 1 fig., 4 tables, 5 refs.

DANGERFIELD, W. G. 1946. Toxicity of DDT to Man. Brit. Med. Jour. No. 4535:27.

DE MEILLON, B., GOLBERG, L., and LAVOIPIERRE, M. 1945. The nutrition of the larva of *Aedes aegypti* L. I. [no title]. Jour. Expt. Biol. 21(3–4):84–89, 4 tables, 3 refs.

DETINOVA, T. S. 1945. On the influence of glands of internal secretion upon the ripening of the gonads and the imaginal diapause in *Anopheles maculipennis*. Zool. Zhur. (Moscow). 24(5):291–298, 1 table, 8 figs., 21 refs. [In Russian.]

DOWNS, W. G. 1946. Results in an infantry regiment of several plans of treatment for vivax malaria. Amer. Jour. Trop. Med. 26(1):67–86, 5 tables, 4 figs., 4 appendices.

———— and PITTENDRIGH, C. S. 1946. Bromeliad malaria in Trinidad, British West Indies. Amer. Jour. Trop. Med. 26(1):47–66, 7 figs., 5 tables.

DUMBLETON, L. J. 1945. "666" and "DDT" as mosquito larvicides. New Zeal. Jour. Sci. and Technol., 27(2):133–134.

ECKSTEIN, A., and NIXON, W. C. W. 1946. Congenital malaria. Brit. Med. Jour. No. 4446: 432–433, 4 refs.

EIDE, P. M., DEONIER, C. C., and NOTTINGHAM, E. 1946. Quick-breaking fuel-oil emulsions containing DDT. MOSQUITO NEWS 6(1): 17–19, 2 tables, 1 ref.

EKLUND, C. M. 1946. Human encephalitis of the western equine type in Minnesota in 1941: Clinical and epidemiological study of serologically positive cases. Amer. Jour. Hyg. 43(2): 171–193, 12 tables, 11 figs., 15 refs.

GABALDON, A. 1945. Métodos estadísticos aplicados en malariologia: III. La malariometria. Tijeretazos sobre malaria (Venezuela) 9(3):55–86, 10 refs. (Processed.)

GEIGER, J. C. 1946. Disease of malaria. Pest Control and Sanit. 1(3):16.

GINSBURG, J. M. 1946. Composition of DDT products. MOSQUITO NEWS 6(1):29–31.

———— 1946. Chemical methods for analysis of dichloro-diphenyltrichloroethane (DDT). Jour. Econ. Ent. 39(2):174–177, 2 tables, 19 refs.

GLASGOW, R. D., and COLLINS, D. L. 1946. The thermal aerosol fog generator for large scale application of DDT and other insecticides. Jour. Econ. Ent. 39(2):227–235, 24 figs., 3 refs.

GOLBERG, L., DE MEILLON, B., and LAVOIPIERRE, M. 1945. The nutrition of the larva of *Aedes aegypti* L. II. Essential water-soluble factors from yeast. Jour. Expt. Biol. 21(3–4): 90–96, 6 tables, 20 refs.

GORGAS MEMORIAL LABORATORY. 1946. Annual report of the Gorgas Memorial Laboratory, 1945. 79th Cong., House Doc. No. 396. 35 pp., 23 tables.

GRELL, SR., M. 1946. Cytological studies in *Culex*. I. Somatic reduction divisions. Genetics 31(1):60–76, 31 figs., 32 refs. II. Diploid and meiotic divisions. Ibid. 77–94, 24 figs., 43 refs.

GUIDETTI, C. 1940. La diagnosi precoce della dengue negli europei al tropici. Riv. di Biol. Colon. 3:197–214.

GUZEVITSH, A. V. 1945. The consequences of the penetration of the African *Anopheles* to South America. On the blood-sucking dipterous insects of the Low Volga. Priroda No. 2:73–74, 3 ref. (In Russian.)

HAAS, V. H., WILCOX, A., DAVIS, F. P., and EWING, F. M. 1946. *Plasmodium gallinaceum* infection characterized by predominance of exoerythrocytic forms. U. S. Pub. Health Serv. Rpts. 61(25):921–928, 4 tables, 3 refs.

HATCHETT, S. P. 1946. Chlorine as a possible ovicide for *Aedes aegypti* eggs. U. S. Pub. Health Serv. Rpts. 61(19):683–685, 1 table, 1 ref.

HAMPTON, B. C. 1946. Malaria: Numbers of cases reported by the State Health Officers in 1945 as compared with similar data for the years 1939–44. U. S. Pub. Health Serv. Rpts. 61(19):679–683, 4 refs.

HARGETT, M. U. 1941. Les moustiques dans les aeronefs. Off. Internatl. d'Hyg. Pub. (Paris) Bul. Mens. 33:279–287.

HAWKING, F. 1945. Growth of protozoa in tissue culture. 1. *Plasmodium gallinaceum*, exoerythrocytic forms. Roy. Soc. Trop. Med. and Hyg. Trans. 39(2):245–263, 29 figs., 12 refs.

HILL, R. B. 1945. Some common mosquitoes of Jamaica and what to do about them. Glimpses of Jamaican Natural History, pp. 43–45.

HIJO, F. L. 1945. La situacion de la fiebre amarilla en Venezuela. Pan Amer. Union Bol. de la Ofic. Sanit. 24(9):779–783, 1 table, 3 maps.

HOOGSTRAAL, H., and CHAMBERLAIN, R. W. 1946. The larva and male of *Aedes (Skusea) amesii* (Ludlow) (Diptera, Culicidae). Wash. Ent. Soc. Proc. 48(5):125–131, 2 figs.

HOVANITZ, W. 1946. Comparisons of mating behavior, growth rate, and factors influencing egg-hatching in South American *Haemogogus* mosquitoes. Physiol. Zool. 19(1):35–53, 5 figs., 10 tables, 13 refs.

HUFFAKER, C. B., and BACK, R. C. 1945. A study of the effective flight range, density, and seasonal fluctuations in the abundance of *Anopheles quadrimaculatus* Say in Delaware. Amer. Jour. Trop. Med. 25(2):155–161, 5 figs., 2 tables, 14 refs.

HUTZEL, J. M. 1946. Protecting marines from insect-borne diseases. MOSQUITO NEWS 6(1): 36–37.

JACOBS, H. R. 1945. Immunization against malaria. Unsuccessful attempts to increase resistance of ducklings to *Plasmodium lophurae* infections by previous injections of materials containing the Forssman antigen. Amer. Jour. Trop. Med. 25(2):151–153, 2 tables, 1 ref.

KARTMAN, L. 1946. A note on anopheline vectors of *Wuchereria bancrofti* in West Africa. Jour. Parasitol. 32(1):91–92, 1 table.

KING, W. V., and HOOGSTRAAL, H. 1946. Three new species of *Aedes* from Netherlands New Guinea. Wash. Ent. Soc. Proc. 48(4):95–106, 7 figs., 3 refs.

———— ————,1946. Species of *Aedes*

*(Finlaya)* of the Papuensis group in the Australasian region (Diptera, Culicidae). Wash. Ent. Soc. Proc. 48(6):135–157, 54 figs.

LAEMMERT, H. W. 1946. Studies on susceptibility of *Marsupialia* to different strains of yellow fever virus. Amer. Jour. Trop. Med. 26(1):33–46, 8 tables, 10 refs.

LEGAC, P., SEITE, P., and COMBESCOT DE MARSAQUET, G. 1945. Etude sur le paludisme a Ouagadougou. Soc. de Path. Exot. Bul. 38(7–8): 201–216, 1 fig., 4 tables.

LEGALL, R. 1944. Le paludisme en Afrique Occidentale Francaise, au Togo et a Madagascar en 1941. Off. Internatl. d'Hyg. Pub. (Paris) Bul. Mens. 36:203–224.

LEVER, R. J. A. W. 1945. The mosquito *Aedes vigilax*—a corrected distribution for Fiji. Fiji Dept. Agr., Agr. Jour. 16(3):90, 3 refs.

———— 1945. Further notes on the *Aedes* or "Tiger" mosquitoes. Fiji Dept. Agr., Agr. Jour. 16(4):99–100, 5 refs.

LEWIS, D. J. 1945. Observations on the distribution and taxonomy of Culicidae (Diptera) in the Sudan. Roy. Ent. Soc. London, Trans. 95(1):1–24, 2 maps, 2 tables, 22 refs.

LINDQUIST, A. W., JONES, H. A., and MADDEN, A. H. 1946. DDT residual-type sprays as affected by light. Jour. Econ. Ent. 39(1):55–59, 4 tables.

————, MADDEN, A. H., and SCHROEDER. H. O. 1946. Effect of temperature on knockdown and kill of mosquitoes and bedbugs exposed to DDT. Kans. Ent. Soc. Jour. 19(1):13–15, 2 tables, 1 ref.

————, TRAVIS, B. V., MADDEN, A. H., and JONES, H. A. 1946. Aerosol formulation, laboratory tests with pyrethrum and DDT aerosols against the common malaria mosquito and the housefly. Soap and Sanit. Chem. 22(5):135, 137, 139, 141, 143, 1 fig., 2 refs.

LOEB, R. F., and coworkers. 1946. Activity of a new antimalarial agent, chloroquine (SN 7619). Amer. Med. Assoc. Jour. 130(16):1069–1070.

MADDEN, A. H., LINDQUIST, A. W., and KNIPLING, E. F. 1946. DDT-treatment of airplanes to prevent introduction of noxious insects. Pest Control and Sanit. 1(3):19.

————, ————, TRAVIS, B. V., and KNIPLING, E. F. 1946. Outdoor control of adult mosquitoes with DDT or pyrethrum applied with ground equipment. MOSQUITO NEWS 6(1):7–11, 3 tables, 3 refs.

MAGOON, E. H. 1945. Drainage for health in the Caribbean area. Salub. y Asist. Social Bol. Ofic. 48(8–10):407–614, 80 plates.

MAKARI, J. G. 1946. Intradermal test in malaria. Jour. Trop. Med. and Hyg. (London) 49(2):23–29, 4 tables, 6 figs., 6 refs.

———— 1946. Cephaline flocculation test in malaria. Brit. Med. Jour. No. 4442:272–273.

MAXFIELD, J. R. 1946. Malaria. Dallas Med. Jour. 32(1):43–46.

MCGOVRAN, E. R., FALES, J. H., and GOODHUE, L. D. 1946. New formulations of aerosols dispersed by liquefied gases. Jour. Econ. Ent. 39(2):216–219, 3 tables, 1 fig., 5 refs.

MCLINTOCK, J. 1946. Collecting and handling mosquitoes on western equine encephalitis investigations in Manitoba. Canad. Jour. Res. Sect. E, Med. Sci. 24(2):55–62, 2 figs., 7 refs.

MORLAN, H. B. 1945. Dengue fever mosquito control at Galveston, Texas. Tex. Acad. Sci. Trans., 1944. 28:112–117, 6 refs.

NAGENDRA, S. 1945. Dry leaf packing for the control of mosquito breeding. (Abstract.) Malaria Inst. India, Jour. 6(2):251.

NEAL, P. A., and VON OETTINGEN, W. F. 1946. The toxicity and potential dangers of DDT to humans and warm-blooded animals. Med. Ann. D. C. 15(1):15–19, 9 refs.

————, SWEENEY, T. R., SPICER, S. S., and VON OETTINGEN, W. F. 1946. The excretion of DDT (2, 2-bis-(p-chlorophenyl)-1, 1, 1-trichloroethane) in man, together with clinical observations. U. S. Pub. Health Serv. Rpts. 61(12):403–409, 2 tables, 4 figs., 7 refs.

NETTLES, W. C. 1946. DDT—Farm and home uses. Clemson Agri. Col. S. C., Cir. 284, 14 pp., profusely illus.

NOEHREN, T. H. 1946. Malaria in Panama. U. S. Bur. Med. and Surg., U. S. Nav. Med. Bul. 46(6):877–884, 1 table, 1 graph, 10 refs.

NORRIS, M. 1946. Recovery of a strain of western equine encephalitis virus from *Culex restuans* (Theo.) (Diptera: Culicidae). Canad. Jour. Res. Sect. E, 24(2):63–70, 2 tables, 17 refs.

PAL, R. 1945. On the bionomics of *Anopheles culicifacies* Giles. III. The behavior of adults. IV. Hypothesis of the races of *A. culicifacias*. Malaria Inst. India, Jour. 6(2):217–241, 9 charts, 9 tables, 1 fig., 36 refs., 2 appendices.

PARAENSE, W. L. 1945. A transmissae de *Plasmodium gallinaceum* pelo *Aedes (Ochlerotatus) lepidus*. Inst. Oswaldo Cruz. Mem. 42(1): 81–84, 3 refs.

QUEZADA, H. 1945. Malaria control and public health in Guatemala. Hosp. Prog. 26:325–327.

RAMOS, A. S. 1945. Observaçoes sobre o *Anopheles (Nyssorhynchus) rondoni* (Neiva e Pinto 1922) e mais um anofelino do Brasil. Arg. de Hig. e Saude Pub. 10(23):9–(18), 5 figs., 1 map, 1 table, 11 refs.

RAO, B. A. 1945. Malaria in the Irwin Canal area, Mysore State. I. [No title.] Malaria Inst. India, Jour. 6(2):101–108, 3 maps.

————, and NASSIRUDDIN, M. 1945. Malaria in the Irwin Canal area, Mysore State. II. [No title.] Ibid., pp. 109–123, 13 tables, 3 charts, 3 appendices, 3 refs.

REES, D. M. 1945. Annual report summary of the Salt Lake City Mosquito Abatement District, 1945. Salt Lake City, Utah, 10 pp., 4 figs.

———— 1945. Supplemental notes on mosquito fish in Utah, *Gambusia affinis* (Baird and Guard). Copeia 4:157–159.

REMPEL, J. G., RIDDELL, W. A., and MCNELLY, E. M. 1946. Multiple feeding habits of Sas-

katchewan mosquitoes. Canad. Jour. Res. Sect. E, Med. Sci. 24(2):71–78, 3 tables, 13 refs.

RIBBANDS, C. R. 1946. Anopheline life-cycles and poplation fluctuations. Nature (London) 157(3982):232–233, 1 ref.

ROARK, R. C., and MCINDOO, N. E. 1946. A second digest of the literature on DDT (May 1, 1944, to December 31, 1944). U. S. Bur. Ent. and Plant Quar. E-687, 73 pp. (Processed).

ROTH, L. 1946. The larva and pupa of *Uranotaenia bimaculata* Leicester on Okinawa Shima, Ryukyu Retto (Diptera: Culicidae). Wash. Ent. Soc. Proc. 48(3):67–75, 5 tables, 2 figs., 6 refs.

ROUBAND, E. 1945. Le probleme de l'espece chez le moustique commun *Culex pipiens* L. Soc. de Path. Exot. Bul. 38(1–2):47–60, 3 figs., 9 refs.

———— 1945. Resistance au jeune hibernal chez le moustique commun *Culex pipiens* L. Soc. de Path. Exot. Bul. 38(3–4):105–111, 5 refs.

————, and COLAS-BELCOUR, J. 1945. Le froid et les facteurs d' eclosion de l'oeuf chez l'*Aedes geniculatus* Oliv. Soc. de Path. Exot. Bul. 38(3–4):111–118, 1 fig., 5 refs.

RUSSELL, P. F. 1946. Lessons in malariology from World War II. Amer. Jour. Trop. Med. 26(1):5–13, 14 refs.

SCHROEDER, H. O., MADDEN, A. H., LINDQUIST, A. W., and JONES, H. A. 1946. Concentrated sprays tested for utility in control of flies and mosquitoes. Soap and Sanit. Chem. 22(4):145, 147, 153, 2 refs.

SCHUTZ, R. B. 1945. Filariasis. Calif. and West. Med. 63(5):221–224, 3 refs.

SCOTT, J. A. 1946. Insect repellents. Texas Reports on Biology and Medicine 4(1):3–6, 4 refs.

SENIOR-WHITE, R., GHOSH, A. R., RAO, J. V. V. 1945. On the adult bionomics of some Indian anophelines: With special reference to malaria control by pyrethrum-spraying. Malaria Inst. India, Jour. 6(2):129–215, 15 tables, 3 charts, 46 refs.

SHUTT, C. H. 1946. Malaria in St. Louis area. Amer. Med. Assoc. Jour. 130(12):815.

SIMMONS, S. W. 1946. Investigations at the Henry R. Carter Memorial Laboratory of the United States Public Health Service. Jour. Econ. Ent. 39(1):15–17.

STAEBLER, A. E., and BUREN, W. F. 1946. *Aedes tortilis* (Theobald), a mosquito new to the United States. U. S. Pub. Health Serv. Rpts. 61(19):685.

STRANDTMANN, R. W. 1945. Malaria and its vectors in the Gulf Coast area of Texas. Tex. Acad. Sci. Proc. and Trans. (1944) 28:106–108.

STAGE, H. H. 1946. Facts and fallacies about DDT. MOSQUITO NEWS 6(1):1–6.

———— 1946. Mosquitoes and other insects killed by aerial spraying with DDT in Panama. MOSQUITO NEWS 6(1):12–13, 1 fig.

———— 1946. The use of DDT residual sprays in native Mexican homes for controlling *Anopheles pseudopunctipennis* mosquitoes. MOSQUITO NEWS 6(1):38.

STUTZ, F. H. 1946. Dade County (Fla.) Anti-Mosquito District. 1945. 11th Ann. Rpt. 20 pp. (Processed).

THOMPSON, P. E., and HART, T. A. 1946. *Plasmodium lacertiliae* n. sp., and other Saurian blood parasites from the New Guinea area. *Jour. Parasitol.* 32(1):79–82, 1 table, 8 figs.

TRAVIS, B. V. 1946. Effectiveness of DDT as a residual treatment of bed nets. MOSQUITO NEWS 6(1):25–26, 1 table, 1 fig.

TREMBLEY, H. L. 1946. The American Mosquito Control Association field trip to the Washington, D. C., area. MOSQUITO NEWS 6(1):34–36.

TUMULTY, P. A., NICHOLS, E., SINGEWALD, M. L., and LIDZ, T. 1946. An investigation of the effects of recurrent malaria. Medicine 25(1): 17–75, 11 charts, 26 tables, 43 refs.

UNITED STATES BUREAU MEDICINE AND SURGERY. 1944. Epidemiology of diseases of Naval importance in Formosa. U. S. Bur. Med. and Surg., Nav. Med. Bul. 266:1–64, 6 appendices

UNITED STATES PUBLIC HEALTH SERVICE. [n.d.] Malaria Control in War Areas. So you've had malaria. 20 pp., illus. Atlanta, Ga.

UNITED STATES WAR DEPARTMENT. 1945. DDT insecticides and their uses. U. S. War Dept. Tech. Bul. T B Med. 194, 32 pp.

VISQANATHAN, O. K., RAO, T. R., and RAO, T. S. R. 1945. The behaviour of *Anopheles fluviatilis*. IV. Experiments on the behaviour of gravid females. Malaria Inst. India, Jour. 6(2):243–245, 3 refs.

WARNER, W. P. 1945. The operation of a DDT residual spraying program in Alabama. Med. Assoc. Ala., Jour. 15(5):174–175.

WARREN, V. G., WARREN, J., and HUNTER, G. W. 1946. Studies on filariasis. I. Serological relationships between antigenic extracts of *Wuchereria bancrofti* and *Dirofilaria immitis*. Amer. Jour. Hyg. 43(2):164–170, 1 fig., 12 refs.

WASICKY, R., and UNTI, O. 1945. Dicloro-difenil-tricloro-etano (DDT); ulteriores pesquisas sobre as suas propriedades e aplicaçoes. Arg. de Hig. e Saude Pub. 10(23):(49)–64, 2 tables, 5 refs.

WENYON, C. M. 1945. Tropical medicine in war and peace. Roy. Soc. Trop. Med. and Hyg. Trans. 39(2):177–194.

WEST, T. F., and CAMPBELL, G. A. 1946. DDT the synthetic insecticide. 301 pp., illus. London.

WISECUP, C. B., BROTHERS, W. C., and EIDE, P. M. 1946. Tests on the airplane application of DDT for the control of adult mosquitoes in open, unwooded areas. MOSQUITO NEWS 6(1): 20–24, 2 tables, 3 refs.

————, ————, ————, and DEONIER, C. C. 1946. DDT emulsion applied to rice-field water to control mosquitoes. Jour. Econ. Ent. 39(1): 52–55, 1 table, 2 refs.

————, MINNICH, V. S., and WHITE, W. C. 1946. DDT applied with hand equipment for the control of salt-marsh mosquito larvae. MOSQUITO NEWS 6(1):14–16, 1 table, 4 refs.

YETTAU, L. E. 1946. Bigger and better spraying units. MOSQUITO NEWS 6(1):27–29, 1 fig.